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[SECOND SERIES.]

ART. I.—*On Three several Hurricanes of the American Seas and their relations to the Northers, so called, of the Gulf of Mexico and the Bay of Honduras, with Charts illustrating the same;* by W. C. REDFIELD.

(Continued from p. 16.)

*Gale or Norther of the Gulf of Mexico in October*, 1842.

THIS storm appeared at the southwestern borders of the Gulf of Mexico at the close of September and beginning of October; but from what direction it arrived in that region, does not clearly appear. We may suppose its previous course to have been westwardly, like other storms of these latitudes; and on almost any hypothesis its route must have been, in part, on the nearly adjacent portions of the Pacific Ocean and the gulf of Tehuantepec, a region which has long been noted for its tempestuous character.*

From the region first mentioned, this gale appears to have moved in a northeastwardly or more easterly course through the Mexican sea, across the peninsula of Florida, and over the Atlantic Ocean, touching the Bermudas, till, near the 60th degree of west longitude, it becomes lost to our present inquiries.

* Vide HUMBOLDT's New Spain; New York, 1811, Vol. I, pp. 21, 64—66. The Pacific coast of Central America being seldom visited by our navigators, we are unable to obtain reports from that region.

The route of this storm is indicated on Chart I, (track XIII;) and our reports and observations which relate to it are as follows. (See also Chart III; where the localities are indicated numerically.)

1. Weather at Vera Cruz, as per logbook of H. M. S. *Ringdove*:*—Sept. 29, A. M., wind N. N. W., force 4–2, b. c.; P. M., N. N. W. 4, b. c.—N. N. W. 6; o. c. q. r. At sunset struck topmasts and pointed yards to the wind; N. 7, q. r.—midnight, N. 8, b. c. q. Sept. 30th, b. c., wind N. 7; N. W. 5; W. 2; N. N. W. 6–7;—midnight, N. N. W. 6. Oct. 1st, A. M., b. c., wind N. N. W. 5; N. W. 4; P. M., W. N. W. 5, o. c. q.; N. N. W. 7, o. c. q. r.;—midnight, N. N. W. 6, o. c. q. Oct. 2d, A. M., wind N. N. W. 6, o. c. q.; N. W. 5, 4, b. c.;—P. M., N. W. 4; N. N. W. 5, b. c. Wind more moderate on the 3d, but continued N. N. W. and N. W. till about noon of the 4th. [This storm at Vera Cruz was a proper Norther of the Mexican coast, and its duration from Sept. 29th to Oct. 2d, shows its progress to have been very slow at that time. This protracted duration is not unfrequent, but rather common in the Northers at Vera Cruz. This may be ascribed, with probability, to the cessation of the westerly progression of the storm, and the gradual commencement of an easterly course.]

2. The Mexican brig *Secunda Fama* sailed from Vera Cruz on the 29th September. On the 2d of October in sight of the bar, [of Tampico, lat. 22° 15′,] was suddenly attacked by a violent gale of wind, which drove her on a reef of rocks four miles northward of Lobos Island, [lat. 21° 30′, lon. 97° 24′,] where the vessel filled, and those on board lost all hope of escape. On the morning of the 3d the clouds cleared away, and they discovered the Texan sloop of war *Austin* under the lee of the island, whose officers succeeded in reaching the wreck with a life-boat, saved the people, and landed them at Tampico.—(*Marine Report.*) [The shorter duration of the gale here than at Vera Cruz, shows a nearness to its northwestern border.]

3. The schr. *Caroline*, from Metamoras, took the gale at N. E., Oct. 1st, about 100 miles east of the Rio Grand del Norte; the wind first veered eastward, [as the vessel moved southeastward,] and afterwards by N. to N. W. The gale lasted through the 2d of October, and the schr. was driven near to the Campeche Bank.—(*Statement of Capt.* COLLINS.)

4. The brig *Sabine*, for Campeche, went ashore at the Alacranes, on the Campeche Bank, [lat. 22° 30′, lon. 89° 43′,] Oct. 2d, in the hurricane, after cutting away both masts; was left in two feet of water after the sea went down.—(*Marine Report.*)

5. The ship *St. Mary* left the bar of the Mississippi on the 29th of September; on the 30th, wind E. N. E., squally, and a rolling sea *from S. E.;* lat. at noon 26° 33′, lon. 88°; prepared for bad weather. Oct. 1st, at noon lat. 25° 40′, lon. 88° 20′; calms and sudden gusts. Oct. 2d, before daylight the sea ran in all directions, as if at a distance the gale was blowing in a circle towards its center. At noon lat. 25° 20′, lon. 88° 40′; dense clouds in the eastern horizon and a cross sea.

At 7 P. M. on the 2d, after a calm, a tremendous gust from the east struck the ship; the hurricane had now commenced in earnest, and with a force seldom felt. The wind continued without cessation; and early in the morning of the 3d, the ship was hove to under a small storm staysail, which soon blew to fragments. Lat. at noon 24° 10′, lon. 89°;† the wind from the *East* continued to blow without intermission, with tremendous force; the sea ran cross and high, and the deck load was thrown overboard. Shortly after noon the wind veered suddenly to North, and blew with increased fury. The east sea, breaking in upon the decks, swept away from the lashings every movable article, burst in the front of the cabin and filled it with water. About 4 P. M. the wind shifted suddenly to the westward and blew, if it was possible, with still greater fury—the ship now on her beam ends, and the sea making a clear breach over her. It being evident the ship was settling and must soon go to the bottom, the only resource was adopted of cutting away

* For an explanation of Capt. BEAUFORT's meteorological symbols, see note at page 4.

† Capt. FOSTER states that his D. R. longitudes were found too far east, on getting an observation, owing to the strong westerly current then prevailing.

the masts, and the topmasts and foremast went over the side. At 6 P. M. the extreme fury of the tempest ceased, leaving a prodigious sea, and the ship lay during the night a helpless wreck.*

The position at noon of the 4th, by good observations, was lat. 23° 57′, lon. 89° 30′, near the Bank of Campeche.—(*Journal of Capt.* FOSTER.)

6. Barque *Claremont*, from Laguna, on the 3d and 4th of October, lat. 25°, lon. 87°, had a severe gale of wind from S. E. to S. W.—(*Marine Report.*) [The veering of the wind in this case from the eastern to the *southern* and western quarter, the course of the storm being northeastward, shows this vessel to have been on the right of the line pursued by the axis of the gale. The opposite course and suddenness of the wind's changes with the *St. Mary*, show this ship to have been in the left center of the storm, and near the line pursued by its axis; the latter passing between the two vessels.]

7. Brig *Jena* was wrecked in the hurricane on the 4th of October, in lat. 25° 35′, lon. 87°.

8. Barque *Helen Maria* encountered the gale of the 4th-5th of October, off the Balize, and returned on the 12th.

9. Brig *Kanhawa*, from New Orleans, on the 4th and 5th of October, lat. 28°, lon. 86° 45′, experienced a violent hurricane from the east; was hove on her beam ends, lost spars, &c.—(*Marine Reports.*)

It may be perceived that this storm advanced but slowly, particularly on its first entrance upon the Gulf of Mexico. Capt. BUNKER, of the ship *Alabama*, for New Orleans, was hence enabled to avail himself of the strong southeasterly winds pertaining to the right front of the storm, in making a rapid passage from near the Tortugas to within forty miles of the bar of the Mississippi, where he hove the ship to, under the main-topsail only, headed to the southward. His statement continues as follows.

10. At sunset on the 4th, the wind continued increasing, the sea running high, and the barometer still falling, I was led to expect a hurricane, and made every thing doubly secure. The wind had veered to about east, and continued increasing, sounding more like thunder than wind. I looked often at the barometer, which was lower than ever I had seen it. At 3 A. M. of the 5th the foresail got loose, and in spite of all efforts was soon destroyed. I made preparation, for the first time in my life, to cut away the masts; but after getting all prepared, I looked at the barometer again and saw it was rising, and discovering at the same time that the wind had veered northwardly, I ordered the men to turn in for sleep; telling the mates they would want close-reefed sail on the ship by 8 A. M., which was the case as it proved. Was about 80 miles from the Balize at the close of the gale.†

Capt. BUNKER states that the ships which were nearer the north shore did not have the wind so heavy; and that the *Deucalion* of Boston carried double reefs till midnight, in order to weather the south point of the delta of the Mississippi.

11. Ship *Norfolk* for New Orleans took the gale about 200 miles from the Balize, [lat. 27°, lon. 86° 20′?] On the 3d the ship was hove to under bare poles. At 4 A. M. of the 4th was hove on her beam ends, and cut away the mainmast. Lost all the sails but one, with most of the spars, and suffered other damage.

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* Capt. FOSTER states that the carcasses of sea and land birds, in great numbers, were floating in the sea the day after the hurricane. These last could not have come from land to the eastward or even northward of the ship, as the winds then prevailed; but must have been blown from southern Mexico or Yucatan by a gale turning south and east around its axis.

† When Capt. B. hove the ship to, he was uncertain of his latitude, having had no observations for two days.

12. Barque *Eliza Thornton*, from New Orleans, experienced tremendous gales on the 4th, in lat. 27°, lon. 86°. Lost topmasts, bulwarks, &c.

13. Brig *Horace*, from New Orleans, took the gale on the 4th, about 100 miles west of the Tortugas; was thrown on beam ends, lost spars, sails, bulwarks, &c.

14. Ship *Charlotte*, in gale of 4th–5th, lat. 28° 30′, lon. 85°, laid to 18 hours under bare poles: lost spars and sails, and suffered other damage.—(*Marine Reports.*)

The next report enables us to mark the access and progress of the *right border* of the storm, between the Tortugas and the western part of Cuba.

15. Barque *Mallory*, for Campechy, Oct. 3d, off Key West, begins with light airs and variable; A. M. strong breezes from S. S. E. and passing clouds: lat. at noon 24° 24′. P. M. commences with strong breezes from S. S. E. and passing clouds; at 8 P. M. took in the light sails; ends with strong breezes and heavy squalls. Oct. 4th, at 2 A. M. wind *South*; double reefed fore and main-topsail, took in jib and mainsail; 8 A. M. close reefed fore-topsail; forenoon strong gales and head sea; lat. obs. 24° 3′, lon. 82° 40′; P. M. commences with strong gale and cloudy; at 2 P. M. close reefed main-topsail, blowing hard in squalls; at 4 P. M. took in fore-topsail: 6 P. M. *wind S. W.*; wore ship, head to the southward, [which tended to carry the ship out of the gale;] midnight, more moderate. Oct. 5th, at 6 A. M. wind *W. S. W.*; at 8 A. M. made sail by the wind; at noon lat. obs. 24° 36′, lon. 83° 20′; P. M. wind W. S. W., moderate breezes and pleasant weather. Oct. 6th, light airs, and passing clouds; lat. obs. 23° 33′, lon. 83° 20′.*—(*Logbook.*)

16. Barque *Christiana*, from Jamaica for Greenock, lost topmasts, &c. in the gale while lying to under bare poles. [Place not given, but probably in the east part of the Gulf of Mexico, and west of the Tortugas.]

17. Brig *T. Street*, from New Orleans for Jamaica, lost masts, sails, &c. in the gale of Oct. 4th; which increased to a hurricane, and continued so for fifteen hours, from every point of the compass. [Position not given.]

18. Brig *Pantheon*, from Tobasco, [south side of the Gulf of Mexico,] was spoken on the 9th, between Matanzas and the south point of Florida, with loss of main-topmast in this gale on the 4th.

19. Schr. *Fancy* dismasted and wrecked in lat. 26° 15′, lon. 82° 23′, (south coast of the peninsula of Florida,) Oct. 6th. [This nautical date probably refers to the afternoon of the 5th, civil time.]

20. The brig *Ann Eliza*, on the north side of the Gulf of Mexico, off Cape San Blas, [about lat. 29° 30′, lon. 86° 20′,] had the gale severe from N. E. Oct. 5th, veering to N. and N. W.—(*Marine Reports.*)

21. Brig *Samson* came to anchor off St. Marks, Florida, [N. E. border of the Gulf of Mexico,] on the 4th, weather squally from the eastward with much thunder and lightning. Every squall became harder, till at 4 A. M. on the 5th, it was blowing a severe hurricane from E. by S., which drove the brig from her anchors, and continued, varying one or two points eastward, till 4 P. M., when it suddenly died away calm. This lasted about fifteen minutes, when the wind came from N. N. W. and blew with increased fury for about three hours, when it began to abate to a common gale of wind, which after 12 hours moderated. During the hurricane no canvass could stand a minute.—(*Statement of Capt.* SAWYER.) [This account marks the border of the *central lull* of the storm's vortex,

* It will have been seen that the successive changes of wind on the south side of the *Antje's* gale, in September, were by the west towards the south, the progress of the gale being *westward*, and this the *left* side of the gale. In this October gale, however, which advanced in an easterly direction, the southerly side of the gale becomes the *right* side, and the order of the changes of wind is consequently reversed. Thus, with the *Mallory* the changes of wind were by the south towards the west, successively, while in the other storm, with the *Solway* and *Rover*, the changes were from westward towards the south. These opposite results necessarily pertain to whirlwind gales which revolve from right to left around their axis, while severally pursuing opposite courses.

which, from the statements of Capt. SAWYER, and of other seamen from this part of the Gulf, appears to have passed between St. Marks and Cedar Keys.]

22. At Cedar Keys, lat. 29° 9′, lon. 82° 56′, the hurricane commenced on the 4th from E. and S. E., and continued on the 5th, from S. E. and S., with heavy rain, till late in the night. On the 6th, cloudy and high winds from N. E. The water is stated to have risen 20 feet above low water mark, and within six feet of covering the island. [This shows the powerful effects of the southerly winds in the right side of the gale.]

23. At Apalachicola, lat. 29° 42′, lon. 85° 5′, Oct. 5th, it blew one of the severest gales on record during the whole day. The wind was at its greatest height about 4 P. M. Most of the houses were unroofed.

24. Fort Brooke, Tampa Bay, Oct. 4th, wind E., fair; 5th, storm, wind E. and. N. E.; 6th, N. E. and E., fair.*

25. Pensacola, lat. 30°, lon. 87° 12′, Oct. 3d, wind E., fair; 4th, N., high winds and rain. [This appears as near the northwestern limit of the storm.] 5th, wind E., cloudy,—S. E., fair.

26. Fort Stansbury, lat. 30° 18′, lon. 84° 8′, Oct. 3d, wind N., fair,—S., cloudy; 4th, E. and N., rain; 5th, N. E., rain and high wind; 6th, N. and N. W., rain; 7th, N. E., fair.

27. Fort Fanning, lat. 29° 38′, lon. 83° 9′, Oct. 3d, wind E., rainy; 4th, E., rain and high winds; 5th, N. and N. E., rain and high winds; 6th, N. and N. E., rain and windy; 7th, N. E., fair.

28. Fort Gamble, lat. 30° 25′, lon. 83° 25′, Oct. 3d, S. E., fair; 4th, N. E., rain; 5th, violent hurricane from N. E. with rain; 6th, N. W., cloudy; 7th, N. E., fair.

29. Fort King, lat. 29° 5′, lon. 82° 7′, Oct. 3d, E., fair; 4th, N. E., rain; 5th, S. E., rain with very high wind; 6th, S. E. and E., cloudy; 7th, S., cloudy.

30. Fort Micanopy, lat. 29° 5′, lon. 82° 5′, 4th, S. E., cloudy, N. E., fair, rain at night; 5th, E. and N. E., latter part a hurricane from S. E. and rain; 6th, N. E., cloudy and high winds; 7th, E., cloudy; 8th, E., fair.

31. Fort Shannon, lat. 29° 31′, lon. 81° 47′, Oct. 3d, N., fair; 4th, N., fair,—N. E., rain, (one third of an inch;) 5th, N. E., heavy gale and rain, (two and a half inches;) 6th, S. W. and N. W., heavy gale and cloudy; 7th, N., fair.

32. St. Augustine, lat. 29° 53′, lon. 77° 1′, Oct. 4th, E., rain A. M.; 5th, great gale from the E. and heavy rain. During the evening the wind varied from S. E. to S., and continued with increased violence during the night. Early on the 6th, the wind hauled round to the west, and somewhat abated; but about ten at night it shifted to due N., and blew much severer than had been experienced for years; 7th, N. E., rain; 8th, N. E., cloudy; 9th, S., fair.—(*Meteorological Reports to the Surgeon General.*)

## Having crossed the peninsula of Florida with the gale, we again take up the Marine Reports.

33. Capt. LIOT, superintendent of the West India line of R. M. steam-ships, informs me that on his return from Nassau (N. P.) to Havanna, after dispatching the Isis, [see 56,] he encountered this gale in some force, on the Bahama Bank.

Barque *Effort*, from S. side of Cuba through the strait of Florida, took the gale on the 6th, lat. at noon, 27° 17′, lon. 79° 30′. At 8 P. M., wore ship and hove to on starboard tack, wind then about N. W. The gale lasted till midnight of the 7th, between N. W. and N. N. W.—(*Statement of Capt.* DAVIS.) [This vessel, aided by the Florida stream, run into the gale after it entered upon the Atlantic, and being under the lee of the peninsula, would be measurably protected from the right hand winds of the gale, but would encounter it in severity from N. W., as the gale become more advanced. It is usual for vessels coming through the strait of Florida, to keep the Gulf Stream as far as Hatteras, unless driven out of it by stress of weather.]

34. Brig *Delaware* had the gale severe on the 6th, lat. 28° 57′, lon. 79° 27′.

35. Packet *Hayne*, bound south, had a hurricane on the 6th and 7th, from all points of the compass, and was hove on her beam ends: lat. 29° 30′, lon. 80° 30′.

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* Reports from the military posts, Surgeon General's Office.

36. Brig *Caspar Hauser* sailed from Matanzas, Oct. 2d; took the gale on the 5th, lat. 30°, lon. 80°, and on the 6th it increased to a complete hurricane. During the night the gale raged with great violence, making a complete breach over the vessel, which had now sprung a leak. On the 7th, while the gale was still blowing, the crew were taken off by Capt. HUFFINGTON, of the barque *Cowper*, which also suffered in the gale. The *Caspar Hauser* had the gale at N. E., veering to N. W. [This shows the brig to have been in the left side of the storm, or N. W. of its axis line.]

37. Schr. *Maria* had the gale from northeastward; was hove on beam ends on the 6th, lat. 30° 30′, lon. 80°.

38 *a*. Barque *Virginia* was dismasted in the gale and abandoned on the 7th, in lat. 30° 30′, lon. 78° 36′ (?) Gale commenced Oct. 5th, from S. E., and continued increasing till noon; then moderated, to 4 P. M.; when it again came out in a tremendous squall from N. E., and continued till noon of the 6th; when, being water-logged, the officers and crew took to the long boat, and were taken up at 4 P. M. by schr. *Maria*, [last mentioned.] The gale continued through the night of the 6th, and moderated afternoon of the 7th.—(*Statement of* THOMAS TABER, *mate of the Virginia.*)

38 *b*. Brig *Florida Banca*, Oct. 4th, had the wind at E. N. E., veering to E. by S.; lat. at noon, 30° 10′, lon. 79° 15′. Oct. 5th, the gale became severe; lat. 31° 44′, lon. 78° 25′; P. M., gale E. N. E., veering to N. E. Oct. 6th, had the very hardest of the gale, from N. N. E.; lat. 31° 31′, lon. 79° 38′. Oct. 7th, wind north, lat. 31° 30′, lon. 79° 3′; wind abating and hauled to the northwestward.—(*Journal of Capt.* ELDRIDGE.)

39. Brig *Peru*, from New Orleans for Baltimore, took the gale in lat. 32° from E. N. E., which veered to W. N. W.

40. Brig *J. A. Lancaster*, for Savannah, took the gale Oct. 5th, ten miles south of Tybee light, [lat. 32°,] carried away spars, and was drifted as far south as lat. 28° 30′, and was in seven fathoms water off Cape Carnavaral.

41. At St. Mary's, Georgia, lat. 30° 44′, lon. 81° 42′, during the gale the waters rose very high; the streets near the river being several feet under water.

42. At Savannah, Georgia, lat. 32° 8′, lon. 81° 10′, Oct. 4th, wind E., fair. On the afternoon of the 5th, the wind commenced blowing hard from S. E. and E., with rain, until about 4 or 5 P. M., when it shifted to N. E., and increased in violence during the night to a hurricane, and continued, with torrents of rain, to 5 or 6 P. M. of the 6th. On the 7th, wind N. E., fair. 8th, the same.

43. At Charleston, (S. C.) lat. 32° 42′, lon. 79° 56′, Oct. 4th, wind E., cloudy, barometer 30·15. Oct. 5th, N. E., cloudy, the weather giving indications of an approaching gale, barometer 30·20; and at the close of the day, it commenced blowing heavily from E. N. E., which continued during the night. Oct. 6th, in the course of the morning, the wind changed to N. E. and N. N. E., and continued to blow a gale throughout the day, with a very high tide; barometer 30 inches. Oct. 7th, 7 A. M., wind N., fair; barometer 30·15; P. M., N. E., cloudy. [The high state of the barometer at Charleston, shows a proximity to the border of the storm, and perhaps an unusual pressure on this border.]

44. At Wilmington, (N. C.) lat. 34° 18′, lon. 78° 2′, the steamers for Charleston were detained in port during the 6th, on account of the gale.

45 Brig *New Hanover*, two days from Savannah, for Philadelphia, had a tremendous gale from E. to N. E.; laid to 18 hours without canvass, and drifted 150 miles southward of Savannah.

46. Ship *Lucas* left Charleston for Boston on the 3d Oct., and on 6th and 7th, had a gale fron N. E., which blew a perfect hurricane: was blown from Cape Romain, [lat 33° 1′, lon. 79° 24′,] to lat. 31°.

47. Schr. *John Hughes*, from Newbern for Barbadoes, was capsized on the 8th, under a storm staysail; one man taken off the bottom on the 11th, in lat. 33° 1′, lon. 77° 40′.

48. Brig *Philura*, on 6th Oct., in a gale off Cape Fear, was knocked down on her beam ends, and partly dismasted.

49. Brig *Hector*, Oct. 8th, lat. 33°, lon. 76° 25′, in a gale from S. E., [?] sprung the mainmast, lost sails, bulwarks, &c.

50. Brig *Orray Taft*, from Charleston for Providence, on the 4th Oct., was in lat 32° 48′, lon. 77° 11′. On the 7th, 8th and 9th, experienced heavy gales from E. to N. N. E.

We have other reports of this gale "off Cape Hatteras," but otherwise indefinite as to location. At a greater distance from the American coast, we have the following observations.

51. Brig *Francis* reports the gale from N. E. on the 7th Oct., lat. 32° 15′, lon. 73° 20′.

52. Schr. *Currency*, at Philadelphia, Oct. 16th, *from Turks Island*, experienced a heavy gale on the 7th and 8th.

53. Brig *Forrest* sailed from Portland, Oct. 2d, for Havanna. Oct. 7th, had strong breezes from E. N. E., and cloudy; at noon began to take in sail, the wind increasing; at 9 P. M., was under close-reefed main-topsail and reefed foresail, wind E. S. E., with a heavy sea; kept before the wind, both pumps going. At midnight the wind backed to E. by N., and blew a perfect hurricane; lay under bare poles, nearly buried in the sea, until 2 A. M. of the 8th. At 2h. 15m. A. M., a heavy blast capsized the brig: cut away the rigging, when the masts broke and the vessel righted. The crew then lashed to the quarter deck, the sea breaking over them, and remained lashed to the wreck till the 9th, [naut. time?] when the wind shifted to the west, and were taken off on the 11th. The position of the brig is not given in this account, but the wreck was seen, Oct. 15th, in lat. 32° 15′, lon. 71° 50′; having probably drifted, in this time, a degree or more to the southward of her position in the gale.

54. Brig *Sally Ann*, Oct. 6th, lat. 30°, lon. 73°, experienced a violent gale from S. E.

55. Schr. *Betsey Richards*, lat. 30°, lon. 71°, Oct. 8th, experienced a heavy gale from S. E., which lasted 54 hours. On the 9th, shipped a heavy sea, and suffered damage. [The dates here are probably nautical time.]

56. This gale caused the final loss of the R. M. steam-ship *Isis*, near Bermuda, Oct. 9th, which had left New Providence, Oct. 3d, at 8 P. M., for Bermuda, in a leaky condition, caused by striking on the rocks at Porto Rico. In the afternoon of Oct. 6th, a breeze sprung up from E. N. E., which gradually freshened, and at noon of the 7th, it blew a gale, with a heavy sea. The gale was heavy on the 8th and 9th, and on the morning of the 10th, the fires stopped, owing to the strain and increased leaking of the ship, and signals of distress were made to the *Medway*, which ship succeeded in taking off the passengers and crew, about 40 miles from Bermuda. On the 10th, the gale had abated.

57. From Bermuda we have the following report, from the journal kept at the signal station, Mount Langton.

| | | | | | | |
|---|---|---|---|---|---|---|
| Oct. 3d, | 9 A. M. | wind N. 1, | cloudy, | bar. 30·03 | Oct. 9th, 1 A. M. | w'd S. E. 9, c. m. r. q. br. 29·91 |
| | 1 P. M. | W. | drizzle, | 30·02 | 9 A. M. | S. E. 7, c. m. 29·92 |
| 4th, | 6 A. M. | E. 1, | rain. | | noon, | S. E. by S. 8, c. m. r. 29·91 |
| | 9 A. M. | N. 3, | cloudy, | 30·02 | 2 P. M. | S. S. E. 8, c. m. d. 29·86 |
| 5th, | 9 A. M. | N. 5, | " | 29·99 | 4 P. M. | S. 7, c. m. 29·84 |
| 6th, | 9 A. M. | N. 4, | " | 30·03 | 5 P. M. | S. W. b. W. 8, c. m. 29·84 |
| 7th, | 9 A. M. | N. E. 5, | c. | 30·13 | 10th, 8 A. M. | S. W. 4, c. m. d. 29·96 |
| 8th, | 9 A. M. | S. E. 6, | b. c. | 30·06 | noon, | N. W. 3, c. r. 29·98 |

[It appears from the above, that the right hand or southern side of the gale passed over Bermuda between the 7th and 10th, the gale being but moderately severe, its axis passing to the north of the island.]

58. The *Sylph*, from New York for Bermuda, encountered contrary winds and heavy weather off that island on the 8th.

59. Brig *James*, for Bermuda, was in lat. 30° 3′, about 270 miles E. S. E. of Bermuda, at 1 P. M. of the 8th, when she first felt the influence of the gale, which increased with strong breezes from S. S. E., and cloudy with passing squalls. Oct. 9th, the wind had veered to S. S. W., and at 4 P. M. the brig was brought to under close-reefed topsails and storm staysails; at 8 P. M. strong wind; at midnight wind W. S. W., squally. At 4 A. M. of the 10th, more moderate; at 6 A. M. made sail, and at 10 A. M. saw Bermuda, 8 miles distant.—(*Logbook.*)

We have no reports from the northern side of the storm at this period, nor any account of its further progress on the Atlantic,

though doubtless it must have been met with by many navigators. We may now take a cursory view of the weather on the two borders of the path of the storm.

From the Caribbean sea, we have no accounts that afford the slightest indication of the presence of the storm, either before or after its appearance in the Gulf of Mexico. On the 2d of October, the Brig *Echo* sailed, with other vessels, from Kingston, Jamaica, for Philadelphia, and met with no storm in those seas. So also the *Effort*, from Jamaica, as we have seen, made her first acquaintance with the gale near the northern part of the strait of Florida. There is the same absence of any evidence with regard to the occurrence of this storm at the great chain of the Antilles, and vessels bound northward from these islands, first encountered the gale north of the islands, in its progress to the eastward.

In front of the gale, we find, that in Florida and elsewhere, a mild state of the winds preceded the arrival of the storm, at successive localities; and further eastward, in its route on the Atlantic, vessels were spoken in mild weather immediately before its arrival.

From the left margin of the storm, we have the following reports; some of which afford indications of the effects or influence of the storm.

60. New Orleans Barracks, Oct. 2d, wind N. E.—N. W., cloudy and light rain; 3d, N. W., light rain; 4th, N., cloudy; 5th, N. E., cloudy.

61. Fort Pike, [nearer the storm,] lat. 30° 10′, lon. 89° 38′, Oct. 2d, wind E., cloudy; 3d, E. and S. E., cloudy; 4th, E., fair; 5th, E. and S. E., fair; 6th, S. E., fair.

62. Fort Morgan, (Ala.) lat. 30° 16′, lon. 88° 10′, Oct. 3d, S. E., fair; 4th, N. E. and N., clouds and drizzly; 5th, N., cloudy; 6th, N. E., fair. [An approximation to the storm seems noticeable on the 4th and 5th.]

63. Mt. Vernon Arsenal, lat. 31° 12′, lon. 88° 15′, Oct. 3d, S. W., fair; 4th, N. E., fair, S. E., slight rain; 5th, S. E., cloudy; 6th, N.—S. W., fair.

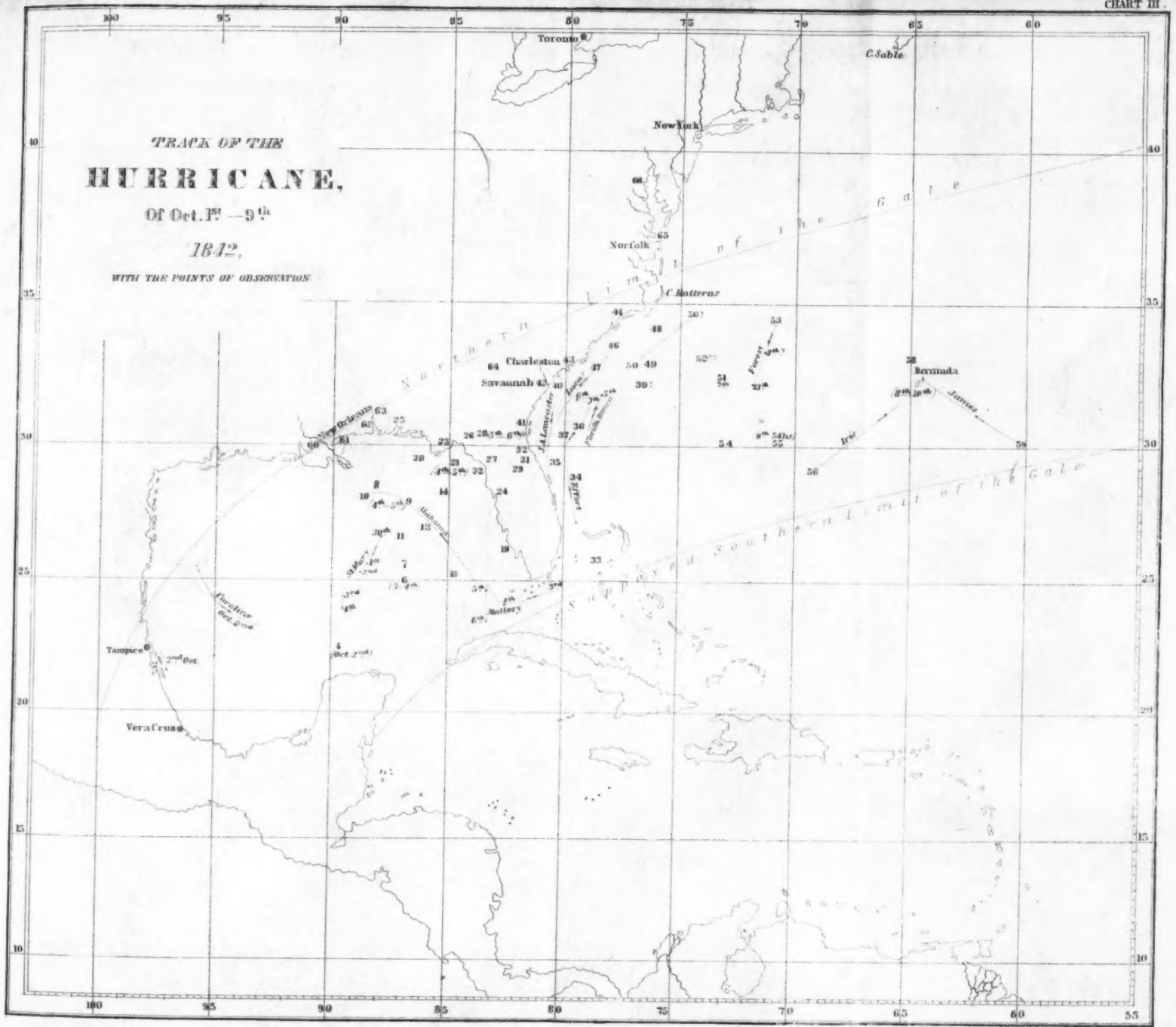
64. Augusta Arsenal, (Geo.) lat. 33° 27′, lon. 81° 30′, Oct 3d, N. E. and E., fair; 5th, E., cloudy; 6th, N. E., fair; 7th, N. E., fair; 8th, N. W., fair.

65. Fort Monroe, (Va.) near Norfolk, lat. 36° 51′, lon. 76° 19′, Oct. 5th, N. E., fair; 6th N. E., fair; 7th, N E., fair, E., cloudy; 8th, S. E., fair; 9th, E., fair.

66. Fort McHenry, Baltimore, lat. 39° 17′, lon. 76° 36′, Oct. 5th, N. W., fair; 6th and 7th, N. E., fair; 8th, N. W., fair; 9th, N. W., rainy.—(*Reports to Surgeon General.*)

At New York, from the 4th to 7th of October, inclusive, in which time the storm had passed this meridian, the winds were light and variable, *the sky perfectly cloudless*, with the barometer ranging from 30·10 to 30·46, averaging 30·289; and no stormy weather occurred till the 14th of the month.

At the magnetic observatory, Toronto, lat. 43° 39′, lon. 79° 21′, from the 3d to 7th, inclusive, calms and light winds prevailed,


TRACK OF THE
HURRICANE,
Of Oct.r 1st —9th
1842,
WITH THE POINTS OF OBSERVATION
Toronto
C. Sable
New York
Norfolk
C. Hatteras
Charleston
Savannah
New Orleans
Bermuda
Tampico
Vera Cruz
Northern limit of the Gale
Supposed southern limit of the Gale
Engd by J.M Atwood N.Y.

mostly with clear weather, the barometer averaging ·158 in. higher than in the preceding month, ·207 in. higher than for the succeeding part of October, and ·212 in. above the annual mean of Toronto.*

But at Bermuda, towards which the storm was moving, the average barometrical pressure during the approach of the storm from the coast of Mexico, was more than one-tenth inch *below* its annual mean. This shows an inequality of pressure of nearly three-tenths of an inch, favoring the route pursued by the storm.

### *Remarks and Generalizations.*

I. Our accounts of this storm are more complete for the northern or left hand side of its axis than on its opposite or southern side, till after it had crossed the Gulf Stream. This seems owing, in part to the course pursued by the gale, and its relations to the common routes of commerce. The less violence of the gale at Vera Cruz than in the heart of the Gulf of Mexico, is in conformity with the usual character of the Northers on that coast, and with the general fact that storms which pass from elevated lands, or even from low countries, do not often act with great force at the surface of the ocean, till at a considerable distance from the coast; this being especially the case with that side of the storm which exhibits an off-shore wind.

II. The rotative character of this gale is well made out by the observed winds as they appear in the several reports, and especially in those of the *Caroline*, *St. Mary*, *Mallory*, *Alabama*, *Samson*, *Betsey Richards*, and at Bermuda, as compared consecutively, and with other parts of the storm, in the proper relations of time and locality.

* In Sept. 1839, the index readings of my barometer were .015 in. higher than the mountain barometer (No. 33) taken to the Toronto observatory, by Lieut. Riddell, who, while in New York, kindly afforded me an opportunity for comparison. The mean of my barometer for that and the five previous years, at 6 and 10 A. M., 2, 6 and 10 P. M., unreduced, was 30·113 in.; elevation of cistern between ten and fifteen feet above the sea level. The interior of the tube is ·26 in. and my readings have been taken from a point between the summit and line of contact of the column, estimated as equal to a level surface. In 1842 my barometer was removed to another station, some six feet higher; and the later annual means induce a suspicion that the index readings may have slightly lessened since that period; perhaps ·010 or ·014:—but this is by no means certain.

The corrections made in this paper of the index readings of some ship barometers, are the results of rough comparisons made, in this port, with my own barometer.

III. The course pursued by the storm, from its first appearance in the Mexican Gulf, appears to have been northeastward, changing more and more eastward, till on crossing the Florida peninsula, its course was near E. N. E.

IV. The length of its observed track, estimated from Vera Cruz to a point in lon. 62°, is nearly two thousand and five hundred miles. If we consider ten days and a half as the time occupied in passing over this distance, it shows an average rate of progress less than *ten miles* an hour. This will account for the extraordinary duration of this gale, which was not at any time remarkable for the extent of its area: and will account in like manner for the inequality of its observed duration, with the several vessels whose movements were different from each other in direction and velocity. In these respects, this gale contrasts very strongly with one which we have yet to consider.

V. This storm deserves notice as pursuing a more easterly course in the lower latitudes than any other storm which has been traced in the American seas. It shows us, so far as is yet known, the extreme southern route of those Atlantic storms which have a northerly and easterly progression from the Gulf of Mexico or its borders. This peculiarity of the storm, viewed in connection with its previous course from the southwestern extremity of the Gulf of Mexico, has strong claims on our attention.

VI. This gale is alike remarkable for the very southern position which must be assigned to the major axis, or apex, of its semi-orbital path; if we suppose that like other storms, it had a previous westerly course, unreported, in still lower latitudes.

VII. A sufficient cause for the above mentioned course of progression, or for the deviation from a more northern and usual course, is found in the relative states of atmospheric pressure at the time northward of the Gulf of Mexico and in the direction of Bermuda, respectively.

VIII. On the Mexican coast, this storm was properly known as a *Norte* or Norther, and like the usual storms or Northers of that region, it blew from northern points of the horizon, veering towards the northwest before its close.

### *A Cotemporaneous Hurricane in the Atlantic.*

There was a very violent hurricane of short duration, narrow limits and more rapid progress, which passed a little northward

of Bermuda near the beginning of the same month. It was encountered, Oct. 2d, by the *Emma*, in lat. 31°, lon. 71°; also, by the *Neptune*, lat. 32° 12′: and by the *Sophia*, lat. 32° 30′, lon. 70°. Next by the *Rienzi*, on the morning of Oct. 3d, in lat. 33° 19′, lon. 67° 32′; and on the same day by the *Cora*, in lat. 34° 10′, lon. 66°. So great was its violence, that nearly all these vessels were dismasted. It is believed that this gale was northward of the Danish island of St. Thomas on the 30th of September, with its border touching this island; and that in its course from thence it curved rapidly northward, to the position of the *Emma*, Oct. 2d, pursuing its course from thence in a northeasterly direction.

### *Description of the Northers of the Mexican Seas.*

The descriptions hitherto given of the storms of this region, seem to be founded chiefly upon phenomena which have been common to particular parts of storms, while moving in certain routes or localities; and hence, as in the case of former descriptions of the West India hurricanes and the storms of the coast of the United States, they have failed to impart any satisfactory knowledge of the general history and progress of these storms.

Mr. MOONEY, an officer of H. M. S. *Thunder*, engaged in nautical surveys, made a passage to Honduras and Vera Cruz in the month of December, 1840, "the very acme of the Northers." He says, "When about 40 miles from Vera Cruz, our forebodings [of the Northers] were realized; we had one of the most severe gales, with the exception of a hurricane, that the West Indies produce, and arrived at Vera Cruz after three days hard battering." Sailing from thence to Tampico, he encountered another Norther, commencing suddenly at N. N. E. Again, on the 11th of January, he arrived in the middle of a heavy Norther at Vera Cruz. Sailed on the 15th, was set to the southeast, "*and thereby escaped a gale that blew to the northward of us.* We had the concomitant swell as long and heavy as usual, but had only light winds, and puffs, and dark lowering weather, with a cross sea, which effectually saved us the trouble of washing ourselves or the deck." Of the Norther he says, "just before it commences the scud can be perceived progressing at no small pace from southeast to northwest.....I think it better for a vessel to keep as near the land as possible on these occasions. The wind blows more along shore—if weather and sky is clear, observations can be obtained. *The gale first lulls in shore, and the heavy dense bank* [of clouds] *can be seen about* 20 *or* 25 *miles out*, and there it hangs till the gale breaks altogether, enveloping many a hapless vessel in darkness, *whilst their more in-shore neighbors enjoy comparatively fine weather.*" [I have italicised certain passages in these and subsequent extracts, as having some important bearing. The above is from the Nautical Magazine for 1841.]

Don BERNADA DE ORTA, captain in the Spanish navy, [who is quoted as authority by HUMBOLDT and others,] states that the season in which the *Norths* blow is from September to March, and that the first of the norths is regularly felt in the month of September. In the winter months, after they begin they increase fast, and in four hours or a little more obtain their utmost strength, with which they continue 48 hours; but afterwards, though they do not cease for some days, they are moderate. They come on so frequently that *there are in general not more than four or six days between them.* There are various signs by which the coming on of a Norther may be foreseen—*but the most certain of all is the ba-*

*rometer*, which at Vera Cruz, in the time of the Norths, varies eight tenths between its highest and lowest range. *The descent of the mercury predicts the Northers*; but they do not begin to blow [at Vera Cruz] the moment it sinks, which it always does a short time *before the North comes on*. Examples are not wanting of the norths happening in May, June, July and August, at which times they are most furious, *being violent hurricanes*, and are called *Nortes del Muero Colorado*. *They begin at the N. E.*, flying round the compass and *settling at N. N. W.* When the wind begins to veer again towards either the east or the west, the gale will soon be over.—(*See* HUMBOLDT'S *New Spain*; *American Coast Pilot*; *Penny Cyclopedia*, *&c.*)

According to HUMBOLDT, both the eastern and Pacific coasts of Mexico are rendered inaccessible for several months by severe tempests, the Norths prevailing in the Gulf of Mexico, while the navigation of the western [Pacific] coasts is very dangerous in July and August, when terrible hurricanes blow from the S. W. At that time, and even in September and October, the ports of San Blas and Acapulco are of very difficult access. Even in the fine season, from October to May, this coast is visited by impetuous winds from N. E. and N. N. E., known by the names of *papagallo* and *tehuantepec*.

It appears in like manner that the coast of Nicarugua and Guatimala, in the Pacific, is visited by violent southwest gales in the months of August and September, known by the name of *tapayaguas*, which are accompanied with thunder and excessive rains; while the *tehuantepec* and *papagallos* exert their violence during a clear sky.

This seems to show that the so called Papagallos, Tehuantepec, and Norther of Vera Cruz, severally, are but the clear weather side of a revolving gale, like the northwester of the coast of the United States; each in its turn being but part of a great vortical storm, which, in certain other portions of its area, or route, often exhibits an abundance of rain.

HUMBOLDT suggested that these northerly winds may blow from the Atlantic and Gulf of Mexico to the Pacific, and that the Tehuantepec and Papagallo, may be merely the effect, or rather the continuation of the north wind of the Mexican Gulf and the *brizottes* of St. Martha. But the vortical character and determinate progression of violent gales was then unknown, and I cannot doubt that the Northers which visit the Pacific coast and the Gulf of Tehuantepec *precede*, in point of time, the same storms in the Gulf of Mexico, and are identical with them, having, commonly, in this region, a northerly progression.

Col. REID says, "it is possible that the Spaniards may apply the term Nortes, or Northers, to more than one phenomenon; but

the violent north winds in the neighborhood of Vera Cruz, are frequently no other than the left hand side of rotatory storms, in their northerly progress across the Gulf of Mexico."* In this remark I fully concur.

### *Identity of Mexican Northers with the Storms of the United States.*

When I first ascertained that many of the hurricanes of the West Indies, had visited the Atlantic coast of the United States, and that here they had severally exhibited the common characters either of southeasters or northeasters, according as one or another part of the storm was presented to our observation, it became alike evident, that our storms were far more numerous and frequent than the hurricanes of the West Indies. It was known, also, that the Mexican Northers were of very frequent occurrence, during our most stormy seasons of the year; while it seemed at least probable, that all great storms were governed by one and the same law, deriving their origin from the lower latitudes.

But the presumption naturally arose, that the courses of these Northers would be found generally parallel with the routes of the several storms which had been traced from the West Indies to our Atlantic coast, and that hence, they would, in most cases, prove to be identical with the storms that are found west of the Alleghanies, which sweep over the interior of the United States and the British provinces;—and to a large extent this is doubtless true. But the absence of sufficient observations from beyond the Mississippi, together with the inert character of many storms and the always more intangible or indistinct character of such as pursue their course overland, has hitherto prevented their direct identification with the Mexican Northers by consecutive observations. Nor was I sufficiently aware that the easterly progression of some of these Northers commenced in lower latitudes than in the previously observed cases of the West India hurricanes.

In October, 1837, the steamboat *Home* was wrecked near Cape Hatteras, and having afterwards occasion to investigate the causes of this disaster, I found that the catastrophe occurred toward the close of a northeast gale, that had previously visited the western

* Second edition of "Attempt to develop the Law of Storms," &c. London, 1841.

and northern coasts of the Gulf of Mexico with great violence, and had passed from thence to the coast of North Carolina. In other words, this Norther of the Mexican coast had become, in due course of progression, an Atlantic storm.

### *Racer's Storm of Jamaica, Mexico and Hatteras, in September and October,* 1837.

On receiving the second edition of Col. REID's work, in Feb. 1842, I found that his attention had also been drawn to the "Northers," and that he had presented valuable data relating to two storms, the *Racer's* hurricane of 1837, and the storm in which Admiral SOLANO's fleet was dispersed in 1780, both of which he viewed as being related to the proper Northers of the Mexican sea. On recurring to my records of the *Home* storm of Oct. 1837, for the purpose of completing these paragraphs, I perceive that this gale must have been identical with the *Racer's* storm of Col. REID. This extension of its observed route serves to confirm the views which he then expressed; while it becomes important as connecting a Norther of the Mexican coast with first a westerly, then an easterly progression, actually observed, and analogous in character to the known progression of the West India hurricanes. (Chart I, track XV.)

Col. REID's earliest account places this storm at Kingston, south side of Jamaica, on the 26th and 27th of Sept., where vessels were driven from their moorings in such manner as seems to show an easterly gale, veering southeasterly. H. M. S. *Racer* took the gale at E. N. E. near the Grand Cayman on the 28th, which increased to a full hurricane; noon of 29th, lat. 19° 43′, lon. 83° 23′; at 7 P. M. was hove on beam ends, dismasted, and righted with 5½ feet of water in the hold; 9·30 P. M. again hove on beam ends, but righted immediately; midnight, hurricane at its full height; at 2·30 A. M. of 30th had veered to E. S. E., still in full force; noon, lat. 20° 12′, lon. 84° 42′, wind E. S. E. but little abated. Oct. 1st, noon, lat. 22° 22′, lon. 85° 36′, in Gulf of Mexico near Cuba; gale abating. H. M. S. *Ringdove* took the gale early on the 28th, blowing from the eastward, on the south side of Cuba, eastward of Trinidad; 29th, increasing from the E.; lat. 21° 21′, lon. 82° 56′, scudding to the westward; 30th, hard gale from E.; lat. 23° 13′, lon. 86° 32′, in the Gulf of Mexico; 7·30 P. M. shipped a heavy sea, stove weather ports and

washed away the binnacles. Oct. 1st, strong gales; 10 A. M. moderating, set close-reefed main-topsail; noon, lat. 23° 16′, lon. 87° 48′, wind E. S. E., under main-topsail, trysails, and fore-stay-sail; morning of 2d, fresh breeze and cloudy; breeze going down. On all this route the phases of the wind show the several observers to have been on the right hand side of the storm's axis.*

I find that the schr. *Active* encountered this hurricane on the 1st of Oct., 47 miles N. of Sisal, (about lat. 22° 10′, lon. 90° 12′,) which lasted thirty eight hours, or, probably, till the morning of the 3d. The schr. *Pomona* which left Sisal in company with the *Active*, was dismasted by it. On the 3d, the schr. *Uncer*, from New Orleans, encountered this gale in the Gulf of Mexico and was driven by it to Galveston Island, where we shall find it on the 5th. The schr. *Cora* for Tampico, had the gale severe, in lat. 24°, lon. 93°, which lasted from the 1st to the 6th of Oct., and was greatly injured. On the 2d, 3d, and 4th, the storm was at Metamoras, on the Rio Grand del Norte, lat. 26°, lon. 97° 30′, and along the coast, where it drove the vessels on shore and prostrated all the buildings at the usual port of the Rio Grand. At Galveston, lat. 29° 20′, lon. 95°, the hurricane drove nearly all the vessels ashore on the 5th, where they were left high and dry, as in the neighborhood of Metamoras. The great influx of the sea on this coast, during the gale, is evidently due to the force and extent of the easterly winds on the right hand side of the storm; which, from the vicinity of Metamoras, was recurving eastwardly in its course.

That the storm did not proceed far into the interior in a northwesterly direction from the Gulf of Mexico, is shown by the meteorological reports to the Surgeon General, from Fort Towson and other western posts. In following its course eastwardly, we find that on the Sabine river, in lat. 30° 51′, lon. 93° 33′, the storm, from N. E. and E., was at its height on the night of the 5th, and continued through the 6th. At New Orleans the gale or hurricane was severe on the 6th, hardest at evening, blowing from S. E. to S., and extending to Baton Rouge and Natchez; at which places it was easterly, and E. N. E., veering north.† At

* For logs and diagram, see REID on the Law of Storms, 2d edition, pp. 138–146.

† I am indebted to Dr. HENRY TOOLEY of Natchez, for regular files of his valuable meteorological observations, which I have found highly useful in these inquiries: also, to Professors LOOMIS and NOONEY for their observations at Hudson, Ohio.

Pensacola Bay it commenced on the afternoon of the 6th, from the eastward, and veered gradually to the S. on the morning of the 7th, and to the W. and N. W. during the day and evening.* At St. Joseph's, West Florida, the gale was severe on the 7th and 8th, from E. round by S., ultimately to N. W., driving all the vessels on shore except one. At Fort Cass, East Tennessee, and in the upper counties of South Carolina, the storm was violent from N. E., veering N., on the 7th and 8th. The gale was on the coast of North Carolina from the 8th to 10th, blowing from N. E. and extending N. of the Chesapeake; with the barometer, at New York, at a maximum of 30·73 in. on the 9th. From the Carolinas it continued its course on the Atlantic Ocean.

The recurvation of this storm to the eastward, from near lat. 26°, was even more sudden and abrupt than that of the Mexican and Bermuda gale, from a lower latitude, which we have already considered. A like cause also for its sudden deflection and unusually eastern course is found in a *plus* state of the barometric pressure in more northern latitudes, at this period. Thus, at New York during the last ten days of Sept., 1837, the mean of my barometer was 30·324 in., and for the first ten days of Oct. 30·279 in.;† being for the twenty days ·216 in. above the mean for that year.

When once the route of this storm from the Gulf of Mexico to the Atlantic Ocean had been ascertained, it was soon discovered that a similar course had pertained to many other storms from the same regions; but with great inequality as regards their frequency in different years. It was found, also, that this early recurvation of storms at some periods, and their easterly courses in lower latitudes, has an important influence on the weather and climate in the northern portion of the United States. This may be seen in the state of the barometer and weather, which we have shown in two important cases, cotemporaneously with the passage of storms over the southern states; and similar weather usually prevails whenever this peculiar course is pursued by the Mexican Northers. For the intervals between our storms are thereby increased, in extent and duration; and hence it is that we enjoy

* Logbooks of the United States' Squadron at anchor in Pensacola Bay; on file in the Navy Department, Washington.

† Or a mean of 30·256 in. for the twenty days, *as corrected and reduced to* 30° *Fahrenheit.*

those placid periods of autumn which are denominated *Indian summers*, of which the cases alluded to are striking examples.

This peculiar course of a portion of the Northers was uncommonly frequent in 1837, a year remarkable for the number and severity of its hurricanes. The autumn of 1845 has also been strongly marked by this peculiarity, with fine weather generally prevailing in the northern states, while severe gales have swept the Gulf of Mexico and thence over the Atlantic Ocean; touching Bermuda in several cases, in one of which the body of the storm is announced to have passed to the southward of the island. In fact, storms of this class are found to occur, with variable frequency, at almost all seasons of the year.

### *New England Storm of December* 15*th*, 1839.

This storm may here be noticed as one of the numerous class of overland storms, which appear to come to us from the interior of the United States and the Mexican territories. In the southwestern and western states this storm comprised the western division of a very extensive but not intense barometric depression, of some days continuance, and like many other storms, was but little distinguished for the development of its anterior winds. The fall of the barometer under these winds, in New York and the middle states, was only about half an inch below the mean of the year. The storm was chiefly remarkable for its violence in New England, on the left side of its axis,—for the extent of the moderate and variable winds about its axis,—for the short duration of the southeasterly and southerly winds of its right front, and for the great extent of westerly winds which were developed in the later part of the gale, which reached even to the border of the trade winds. The route of this storm is now placed on chart I, (track XVI,) in conformity with extensive observations, obtained from the meteorological returns from the military posts, marine reports and other sources.

A number of storms, of greater intensity and more strongly marked outline, may be shown to have pursued a similar course over the interior of our continent and from thence to the Atlantic Ocean. But our attention must next be directed to the Northers which come more directly from the *eastern* portions of Central America.

ART. II.—*Observations on the more recent researches concerning the operations of the Blast Furnace in the Manufacture of Iron;* by Dr. J. L. SMITH.

THE great difference existing between metallurgic operations of the present day, and those of a former period, is owing chiefly to the ameliorations produced by the application of the science of chemistry to the *modus operandi* of the various changes taking place during the operations, from their commencement to their termination.

Copper and some other metals are now made to assume forms in the chemist's laboratory, that formerly required great artistical skill for their production—the chemist simply making use of such agents and forces as are at his command, and over which he has, by close analytical study, acquired perfect control. Our object at present, is only to advert to the chemical investigations more recently made on the manufacture of iron, treating of those changes that occur in the ore, coal and flux that are thrown in at the mouth of the furnace, and in the air thrown in from below. For most that will be said on this subject, we are principally indebted to the recent interesting researches of M. EBELMAN.

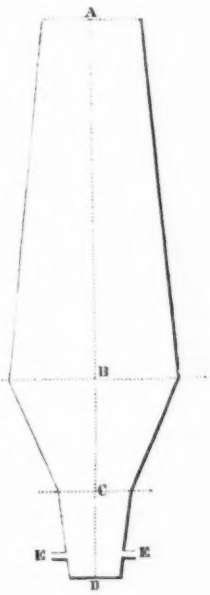
The importance of a knowledge of the facts to be brought forward in this article, will be apparent to every one in any way acquainted with the manufacture of iron. It will be seen, that the time is not far distant, when the economy in the article of fuel, will amount in value to the present profit of many of the works. The consequence must be, that many of those works that are abandoned, will be resumed, and others erected in localities formerly thought unfit.

The daily increase of the demand for this article, in the construction of rail-roads and machinery, and the supply of this country falling short of its demands, are directing a large amount of capital towards the construction of furnaces, rolling-mills, and other iron works. The time is not far distant, when the silent influence of our extensive mineral resources will tend more to lay aside one of our great congressional bones of contention, than all the oratory of our statesmen.

It is well known, that the blast furnace is the first into which the ore is introduced for the purpose of converting it into mallea-

ble iron, and much therefore depends upon the state in which the pig metal passes from this furnace, whether subsequent operations will furnish an iron of the first quality or not. The interior of the blast furnace consists of three conical cavities, represented by the figure.

A, mouth of the furnace.
AB, fire-room "
BC, boshes "
CD, hearth "
EE, openings called tuyers.




The principal parts of the furnace are thus hastily alluded to, so that those not familiar with their names may readily understand what follows. In putting the blast furnace into operation, the first step is to heat it for some time with coal only. After the furnace has arrived at a proper temperature, ore, fuel and flux are thrown in alternately, in small quantities, so as to have the three ingredients properly mixed in their descent. In from twenty five to forty eight hours from the time when the ore is first thrown in, the entire capacity of the furnace, from the tuyer to the mouth, is occupied with the ore, fuel and flux, in their various stages of transformation.

In order to explain clearly, and in as short a space as possible, what these transformations are, and how they are brought about, we may consider—

1. The changes that take place in the descending mass, composed of ore, fuel and flux.

2. The changes that take place in the ascending mass, composed of air and its hygrometric moisture, thrown in at the tuyer.

3. The chemical action going on between the ascending and descending masses.

4. The composition of the gases in various parts of the furnace during its operation.

5. The causes that render necessary the great heat of the blast furnace.

1. *Changes that take place in the descending mass, composed of ore, coal and flux.*—By coal is here meant charcoal; when any other species of fuel is alluded to, it will be specified. In the upper half of the fire-room, the materials are subjected to a comparatively low temperature, and they lose only the moisture, volatile matter, hydrogen and carbonic acid that they may contain; this change taking place principally in the lower part of the upper half of the fire-room.

In the lower half of the fire-room, the ore is the only material that undergoes a change, it being converted wholly or in part into iron or magnetic oxide of iron—the coal is not altered, no consumption of it taking place from the mouth down to the commencement of the boshes.

From the commencement of the boshes down to the tuyer, the reduction of the ore is completed. Very little of the coal is consumed between the boshes and in the upper part of the hearth; the principal consumption of it taking place in the immediate neighborhood of the tuyer.

The fusion of the iron and slag occurs at a short distance above the tuyer, and it is in the hearth of the furnace, that the iron combines with a portion of the coal to form the fusible carburet or pig-iron. It is also on the hearth that the flux combines with the siliceous and other impurities of the ore. This concludes the changes which the ore, coal and flux undergo from the mouth of the furnace to the tuyer.

If the fuel used be wood or partly wood, it is during its passage through the upper half of the fire-room that its volatile parts are lost and it becomes converted into charcoal. M. Ebelman ascertained that wood at the depth of ten feet, in a fire-room twenty six feet high, preserved its appearance after an exposure for $1\frac{3}{4}$ of an hour, and that the mineral mixed with it preserved its moisture at this depth; but three and a half feet lower, an exposure of $3\frac{1}{4}$ hours reduced the wood to perfect charcoal and the ore to magnetic oxide. The temperature of the upper half of the fire-room when wood is used, is lower than in the case of charcoal, from the great amount of heat made latent by the vapor arising from the wood. In the case of bituminous coal, Bunsen and Playfair find that it has to descend still lower before it is perfectly coked.

After the wood is completely charred, or the coal become coked, the subsequent changes are the same that happen in the charcoal furnaces.

2. *Changes that take place in the ascending mass, which is composed of air and hygrometric moisture.*—The weight of the air thrown in at the tuyer in twenty four hours, is twice that of the ore, coal and flux, thrown in at the mouth during the same time.

The air as soon as it enters the tuyer and reaches the first portion of coal, undergoes a change—its oxygen is converted into carbonic acid, and its moisture decomposed, furnishing hydrogen and carbonic oxide—after ascending a short distance, (12 or 18 inches,) the carbonic acid is converted into carbonic oxide—between this point and the upper part of the boshes it undergoes goes but very little change, having added to it a further small amount of carbonic oxide. So the ascending column at the top of the boshes is composed of nitrogen, carbonic oxide and hydrogen—from this point it begins to undergo a change; the carbonic oxide diminishes, carbonic acid appears, and goes on increasing for about half the way up the fire-room; after which the carbonic acid, carbonic oxide and nitrogen remain the same, when the hydrogen increases and moisture begins to appear and augment up to the mouth. The ascending mass as it passes out of the mouth, contains the vapor of water, carbonic acid, carbonic oxide, hydrogen and nitrogen. The nitrogen undergoes no alteration in its passage through the furnace, and the same is true of the hydrogen formed at the tuyer.

If wood be used, the gases passing out of the mouth are the same as those just mentioned, with an increased quantity of moisture, and the addition of those pyroligneous products arising from the dry distillation of wood.

In case of the use of bituminous coal, the gases first alluded to, have added to them ammonia, light carburetted hydrogen, olefiant gas, carburetted hydrogen of unknown composition, and sulphuretted hydrogen.

3. *The chemical reaction occurring between the ascending and descending masses.*—From the foregoing statements, we can at a glance see what are the materials to be met with in the different parts of the furnace, and can therefore readily study their reactions upon each other.

In the upper half of the fire-room little or no chemical action is taking place, the ore, flux and coal, as already stated, simply losing their volatile parts. In the bottom of the upper half and the entire lower half of the fire-room, a reaction is taking place between the ore and the carbonic oxide of the ascending column, iron or magnetic oxide of iron and carbonic acid being the result. It must be borne in mind, that the coal has played no part in this reduction down to the commencement of the boshes. Between the boshes, and in the hearth, no reaction appears to take place between the ascending and descending masses, but the reduction of the ore is completed by the direct action of the coal upon the remaining portion of the undecomposed ore, carbonic oxide being formed, and here is the first consumption of the coal in its passage downwards.

According to M. Ebelman the ore loses in the fire-room $\frac{2}{3}\frac{0}{3}$ of its oxygen by the reaction of the oxide of carbon, and the remaining $\frac{5}{3}\frac{}{3}$ disappears in the boshes and hearth in the manner already stated, at the expense of from $\frac{6}{1}\frac{}{0}\frac{}{0}$ to $\frac{1}{1}\frac{2}{0}\frac{}{0}$ of the entire amount of charcoal used.

The ore being now completely reduced, unites with a portion of carbon in the hearth, melts at about 13 inches from the tuyer, and descends into the crucible; and here also the flux combining with the impurities of the ore forms the slag which melts.

The coal and the air react upon each other most powerfully just in the neighborhood of the tuyer, where the most intense heat is produced; the oxygen becomes converted into carbonic acid, which acting upon a portion of the ignited coal, is almost at the same moment reduced to carbonic oxide; the moisture of air acting on the ignited charcoal undergoes the decomposition already mentioned, hydrogen and carbonic oxide resulting therefrom.

When the ore is easy of reduction, the gas at the boshes is represented by 100 nitrogen and 52·5 carbonic oxide, *plus* the quantity of carbonic oxide and hydrogen afforded by the moisture.

It must be clearly understood that these rules do not apply to every variety of ore. They are especially applicable to the hematites and such ores as are either naturally porous, or become so in their passage through the fire-room of the furnace, thus increasing the surface of contact exposed to the action of the reducing agent, (carbonic oxide,) so that when it has reached the boshes the reduction is nearly complete.

The specular, magnetic, and siliceous ores are reduced with much more difficulty; most of the ore in these cases reaching the boshes but slightly altered, they being principally dependent upon the direct action of coal for their reduction; this circumstance largely increases the consumption of coal when any of these ores are employed; and the amount of caloric made latent, in consequence of the reduction requiring the direct action of the coal, is very great, whereas in the reduction of the ore by carbonic oxide no heat becomes latent: for the heat rendered latent by the oxygen of the ore becoming gaseous, is compensated by the sensible heat produced by the combination of the carbonic oxide with the oxygen. Where the reduction is produced by the carbon, with the formation of carbonic oxide, 1598 unities of heat are made sensible, while 6216 are rendered latent, giving a difference of absolute loss of 4618.

It should be the object of the metallurgist to reduce as much of the iron as possible by the oxide of carbon. Magnetic, siliceous and other hard ores should be reduced to smaller fragments than those softer and more easily managed. Were it possible to reduce them to powder without the danger of choking the furnace, it would be all the better, as the great object is to have a large extent of surface exposed to the carbonic oxide. The different capacity of different ores for reduction, shows the necessity of having furnaces of different dimensions for them respectively.

The matter which covers the melted metal in the crucible, and that which adheres to the interior of the hearth, contain silicate of iron and charcoal in a pasty state, and there is consequently a constant reduction of the oxide of iron, which gives rise to carbonic oxide; this gas bubbles through the slag, which if drawn off at this time, will, when cold, present a porous structure, a sure indication that the furnace is not working well and that the slag itself contains much of the ore in the form of a silicate.

4. *Composition of the gas in various parts of the furnace during its operation.*—The analyses lately made by Ebelman are the most accurate and best detailed that we are in possession of. What follows has reference to a furnace worked with charcoal.

*Gas taken from the mouth of the furnace and dried.*

| | |
|---|---|
| Carbonic acid, | 12·88 |
| Carbonic oxide, | 23·51 |
| Hydrogen, | 5·82 |
| Nitrogen, | 57·79 |

The vapor of water in a hundred volumes of this gas, varies from nine to fourteen volumes. Examinations made at different times show the proportion of hydrogen and nitrogen to be nearly uniform, and that the sum of the volumes of carbonic acid and carbonic oxide is constant, but that there is a variation in their respective proportions.

*Gas taken from the interior of the fire-room at* 5 *to* 10, *and* 13 *to* 17 *feet from the mouth*, (*fire-room* 36 *feet.*) From five to ten feet, the proportion of moisture diminishes, the other ingredients remaining about the same. From thirteen to seventeen feet, the proportion of carbonic oxide increases, while the carbonic acid and hydrogen diminish.

*Gas from the bottom of the fire-room and top of the boshes.* This is remarkable for the constancy of its composition, and for the absence of carbonic acid and watery vapor. Composition—

| | |
|---|---|
| Carbonic oxide, | 35·01 |
| Hydrogen, | 1·92 |
| Nitrogen, | 63·07 |

*Gas from the bottom of the boshes and commencement of the hearth.*

| | |
|---|---|
| Carbonic acid, | 0·31 |
| Carbonic oxide, | 41·59 |
| Hydrogen, | 1·42 |
| Nitrogen, | 56.68 |

*Gas from the neighborhood of the tuyer.*

| | |
|---|---|
| Carbonic oxide, | 51·35 |
| Hydrogen, | 1·25 |
| Nitrogen, | 47·40 |

The two last statements would appear to contradict the rules previously laid down, as regulating the operation of the blast furnace; for, according to them, the proportion of carbonic oxide at the top of the boshes should be a little greater than in the hearth, whereas the reverse would appear to be the case by the analyses here given. Besides, from a glance at the composition of the

three last gases alluded to, it would appear that the gaseous products, as they ascended the furnace, lost completely a portion of the carbonic oxide, without a replacement by carbonic acid or other compound; in other words, a portion of it would appear to be completely annihilated, which of course is an impossibility. This apparent anomaly is easily accounted for, when it is stated how the gas was collected.

In order to obtain the gas from different portions of the furnace, holes were bored into the side, and a tube inserted, by which it was drawn off. Allusion has already been made to the fact that a pasty mass adheres to the sides of the hearth, containing silicate of iron and charcoal, in which there is a constant reduction of the iron, with the formation of carbonic oxide. Now it is evident that the gas drawn off by a hole bored into the side of the hearth, will be largely mixed with this carbonic oxide forming in the immediate neighborhood of the opening, and that it cannot serve as an index to the character of gas passing through the centre of the hearth. M. Ebelman was aware of this fact, but he was not able to overcome the difficulties in the way of obtaining the gas under the proper circumstances.

*Gas taken at the tuyer.*—Here it is little else than atmosphere mixed with a few per cent. of carbonic acid.

From these results it will not be difficult to admit, that the oxygen of the air is converted immediately into carbonic acid, which is rapidly changed into carbonic oxide under the influence of an excess of carbon and the high temperature developed near the tuyer.

5. *The causes that render necessary the great heat of the blast furnace.*—The weight of the ore, flux and combustible, which enters the furnace, being only one half that of the ascending column, and as the specific heat of these three materials is very much below that of the gas of the ascending mass, it is not the heating of them that explains the necessity of the very great heat of the blast furnace. But the principal cooling causes are—

1. The drying of the ore, flux and coal, and the expulsion of carbonic acid from the flux, &c., rendering much of the heat latent; for what was solid is now transformed to the gaseous state.

2. The reduction of the ore, or in other words, the transformation of the solid oxygen of the ore into gaseous oxygen. If the ore has been deprived of its oxygen by the action of carbonic

oxide, with the formation of carbonic acid, the heat rendered latent by the oxygen, is compensated for by the heat developed by the reaction between the oxygen and carbonic oxide; which is the character of the operation that principally takes place in the lower part of the fire-room. If the ore has been deprived of its oxygen by the direct action of the coal, the amount of heat rendered latent is enormous, as already stated; for carbonic oxide is the result of this reaction, and the amount of heat developed by it falls far short of that rendered latent by the oxygen that has entered into its formation, assuming the gaseous condition,—this is the character of the reduction taking place in the boshes and hearth.

3. The conversion of the carbonic acid near the tuyer into carbonic oxide, has a powerful influence in cooling the upper part of the hearth; for of the 6260 units of heat formed by the first action of the air upon the coal, 4662 are rendered latent by the conversion of this carbonic acid into carbonic oxide.

This terminates what it was proposed to treat of; it is little else than a sketch of the chemistry of the blast furnace, sufficient to show its importance.

In a future article, some remarks will be made upon the amount of combustible lost in the operation of this furnace, the recent methods employed to prevent this loss in the complete combustion of coal, the action of the hot blast, theory of the refining furnace, charring of wood, and other points of interest.

Charleston, (S. C.) Nov. 26, 1845.

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## Art. III.—*Genera of Fossil Corals of the family Cyathophyllidæ.*

The following pages on the Cyathophyllidæ are cited from Mr. Dana's work on Zoophytes, one of the volumes of the Exploring Expedition series.* This work embraces all known species of recent zoophytes, exclusive of the Actinidæ, Bryozoa and Sertularidæ, including about 500 species, nearly half of which are for the first time described. The collections of the Expedition

* United States Exploring Expedition, during the years 1838–42, under the command of Charles Wilkes, U. S. N. Zoophytes, by James D. Dana, Geologist of the Expedition; 741 pp. 4to, with a folio atlas of 61 plates. 1846. The atlas is not yet published.

were quite extensive, as their opportunities for making them were peculiarly favorable. The investigations, which extended to the animals of numerous species, suggested so many changes and modifications in various parts of the received systems, that the work necessarily became a complete treatise on Zoophytes. The genera of fossil corals are mentioned in the places where they fall in the classification adopted, with their characteristics. We do not propose to review the work, as Mr. Dana will furnish for future numbers of this Journal a series of articles upon Zoophytes, made up in part from his Treatise; and this we believe will be more acceptable to our readers, especially as only a small edition of the work has been published.

In the following citations, we omit the Latin descriptions.

### Family Cyathophyllidæ.

Caryophyllacea forming calcareous coralla. Gemmation inferior, the buds either lateral or growing upward from the summit. Corallum of a polyp usually transversely or obliquely septate at middle.

The species of this family are so nearly related to one another, and the transitions uniting the widest variations from the type are so gradual, that they have generally been classed together, and originally, a large part constituted a single genus. Yet as the characteristics of the family can be drawn only from fossilized coralla, there is much difficulty in seizing those peculiarities which will satisfactorily exhibit its unity. Moreover, the early forms of organic life had generally a wider range of characters than those of the present day, and seem to have belonged rather to the system of the period than to that now existing.

The coralla* of the Cyathophyllidæ have usually the structure of the Astræidæ, with the inferior mode of budding of the Caryophyllidæ; in the general character of the stars, and the numerous intermediate dissepiments uniting the lamellæ, many of them are near the former, while others have the simple stars of the latter. The most striking characteristic in structure consists in the

* Mr. Dana uses the word *corallum* in place of *polypary* or *polypidom*. The latter words imply that the coral *contains* the polyps in its cells, whereas in fact, there is no more propriety in such a statement than there is in saying that a man is contained in his skeleton. Corallum was used by some ancient writers, and is sufficiently distinct from Corallium, the name of a particular genus of coral zoophytes.

transverse septa and cellules, which constitute the middle of the corallum; in this respect the species most Astræoid, usually differ widely from true Astræas. Many of the species are simple, and in consequence of their not budding, their connexion with the group is determined by analogies in general structure, and by their transitions.

While in a transverse section, the star of the Astræidæ and Caryophyllidæ characterizes a large part of the group, there are others closely allied, (Cystiophylla,) in which the lamella or rays, are barely traceable about the center of the cell, and are lost outward in a general cellular texture; and in some of the same group, the rays are wholly wanting, and the texture of the corallum, in a transverse section, is simply porous or spumous. It is quite probable that this absence of distinct lamellæ, and the cellular texture instead, may depend, as in the Porites and Gonioporæ, on the polyps being long exsert when expanded, only their lower portions, below the visceral cavity, secreting lime.

In a vertical section, the transverse septa are sometimes seen to extend quite across the whole interior, while in other species they are confined to the middle portion, or become almost obsolete. They are seldom regular in their intervals, or in a simple range; on the contrary there is commonly a confusion of transverse cellules through the center of the corallum. In several species, the septa, instead of crossing transversely, are oblique, and merely overlap about the medial line; while in others they extend upwards very obliquely from either side, and meet more or less perfectly in an axis to the corallum. Something apparently analogous to this is seen in certain Astræas; the lamellæ instead of being finished out entire, have the inner edge pectinated obliquely upward, the pectinations extending toward a medial line. Yet the Cyathophyllidæ differ essentially in having, for these oblique lines, prolongations of the intermediate dissepiments which unite the lamellæ, and not of the lamellæ themselves. It appears to be a general principle, that while these intermediate dissepiments are altogether subordinate to the lamellæ in the Astræidæ, in the family under consideration, they are usually stouter than the lamellæ; the transverse septa alluded to, result from their continuation, and more or less perfect union, through the central portions of the corallum, where the radiating lamellæ are often wanting. The axis, in the species with oblique ascending septa,

is sometimes formed by a convolution of the septa or plates, as shown in some Columnariæ. In the Sarcinulæ the septa extend quite from the sides, and appear like a series of funnels inverted upon one another, with a solid axis along the central line.

Michelin first pointed out that certain species have on one side of the cell a narrow triangular depression or cavity, with one or more of the lamellæ in part wanting, and designated the group *Caninia*. This structure cannot be considered altogether anomalous, when we consider that some Madreporæ and Zoanthidæ have one tentacle different in size or color from the others; and we need not look for an explanation of it to an analogy with the siphuncle of the Ammonite.

We observe a farther difference between the coralla of the Astrææ and the Cyathophyllidæ. In the former, when the cells are *not contiguous*, the limits of the stars are formed by a thickening and lateral coalescence of the radiating lamellæ; and the interstices in a transverse section, constitute a narrow band, often cellular, between the several stars; but in the latter, although there may be broad interstices between the cells, there are none between the stars; they are separated only by a simple thread-like line. The lamellæ, or their portions towards the circumference, often become subdivided, as in some recent Caryophyllidæ. It appears therefore that there is a decided difference in the structure of the polyps. In Astræas with *contiguous* cells, we have in a transverse section nearly the same structure as in the Cyathophyllidæ; but, unlike the species of the group before us, they are dichastic in budding, the disks of the polyps generally subdividing by growth. The interstitial buds of this family are in character like those of the Porites and Astroites, in which budding is lateral. The summit buds of the Cyathophyllidæ differ decidedly from the disk-buds of the Astræas. Their production is attended with a sacrifice of the parent, and they consequently grow up as prominent young, like the lateral buds of a Caryophyllia; while in the Astræas, without the intermitted mode of growth and reproduction, and a prolate growth of the summits, the young and parent grow on together with an equal rate of increase.

The Cyathophyllidæ afford examples of both aggregate and segregate Zoophytes. Some species form clumps of branches like those of many Mussæ and Euphylliæ; while in others, the

adjacent polyps coalesce and produce solid massive forms. In a few, the polyps are crowdedly in contact without coalescing, (or are united by their non-secreting exterior,) and in consequence of the mutual pressure, have a prismatic form; and the coralla, though apparently solid, may be readily broken into prisms. The same genus, as in other departments of Zoophytes, may contain both solid, branching, and also simple or non-budding species.

A study of the internal structure of these corals, has led the writer to some changes in the received limits of groups, and also to the introduction of one or two new genera. The generic names of older authors have, in some instances, of late been misapplied; in obedience to the principles relating to nomenclature, digested and brought out by the British Association, a restoration to their original characters has been attempted; and where impracticable, their rejection seemed preferable to retaining them with altered characteristics.

Other errors have arisen from regarding external forms too implicitly, in drawing out generic distinctions. Thus the genera Lithodendron and Columnaria, as employed, include species which are true Cyathophylla, and some allied species have been referred to the genus Caryophyllia (Cladocora, of Ehrenberg,) although differing totally from them and all others of the Caryophyllidæ, in the transverse structure of the interior.

The following are the genera of this family, with their characters. In presenting this review of them, the author is aware that the subject requires much farther study before its difficulties will be wholly removed. We may subdivide them into the following groups.

1. *Those with the cross septa transverse or but little oblique; sometimes nearly or quite obsolete.* Includes the genera Cyathophyllum, Calophyllum, Amplexus, Caninia, Acervularia, Arachnophyllum, Cystiophyllum.

2. *Those with the septa very oblique upward, and converging to a central line, with sometimes a distinct axis.* Includes the genera Clisiophyllum, Michelinia, Columnaria, and Sarcinula.

I. *Transverse septa straight, or but little oblique, sometimes becoming obsolete.*

Genus 1. Cyathophyllum. Quite simple, ramose or glomerate. Corallum within transversely septate; cells concave, regu-

larly stellate; numerous intermediate dissepiments uniting the lamellæ, and the outer portions of the corallum of a polyp, consequently, regularly cellular.

The type of this genus is the *Cyathophyllum dianthus.** The texture of the interior at middle is transversely septate, while either side of this medial portion the texture is cellular. In some species the cellular portion is very narrow, and these form a transition to the genus Calophyllum; this texture may in all instances be perceived on polishing down the exterior, when the surface will appear cellular as described; and the cellules are mostly nearly rectangular. The transverse septa are occasionally much convex.

In the *dianthus* the intermediate dissepiments run obliquely from above *downward and inward;* and the same is true of many other species. There are others in which these dissepiments run *upward and inward*, and as the species have also some difference of habit, they constitute at least a subgenus, if not a wholly distinct group. The name *Heliophyllum* has been applied by Mr. James Hall to a specimen of this kind in his cabinet, and may well be retained. It is represented in his New York Geological Report, fig. 3, p. 209, and is probably near the Cyathophyllum helianthoides of Goldfuss, pl. 20, fig. 2.

The subgenus Heliophyllum will then contain species having generally the transverse septa of the Cyathophylla, but with the intermediate dissepiments running oblique *upward* and inward.

Both solid, ramose and simple species, are included among the Cyathophylla; and we do not deem it necessary to separate the cylindrical and prismatic species, which have a similar internal texture, although heretofore referred in part to the genera Lithodendron, Columnaria, and Caryophyllia. Should they be separated, a new genus should be constituted, as they are not true Caryophylliæ, nor Columnariæ; neither do they belong to the Lithodendrum of Schweigger.

Genus 2. Calophyllum, *Dana.* Quite simple, caliculato-ramose or aggregate. Corallum within transversely septate; cells concave, regularly stellate; no internal dissepiments between the lamellæ, and the sides of the corallum, therefore, not cellular.

The Calophylla pass gradually into the Cyathophylla, but still may be readily distinguished by polishing down the exterior to a depth of a line, when the edges of the vertical lamellæ within are brought into view, and the absence of intermediate dissepiments is apparent. The lamellæ of the cell sometimes appear split open or subdivided towards

* See Murchison's Silurian System, pl. 16, figs. 12, 12*b*; also figs. 9, 10, 11*a*.

the sides, and occasionally dissepiments may be distinguished between the separated parts, when not apparent between the several lamellæ themselves.

Genus 3. Amplexus, *Sowerby.* Stems subcylindrical, uneven. Corallum within transversely septate, septa very broad and nearly straight, extending quite to the sides; cells many rayed.

The species of Amplexus are distinguished by their uneven cylindrical forms, having the internal septa extending quite across the whole interior. They are thus closely related to the Calophylla, and it may be a question whether the two genera should not be united in one, unless it is thought best to pursue the system, apparently impracticable, of forming separate groups of the cylindrical, columnar, and massive species of the genus Cyathophyllum.

The name *Cyathophora* has been applied by Michelin to fossil corals near the above, but massive in structure, and the rays obsolescent. They are often prismatic, like the Favosites, though larger. They may be viewed as massive species either of Amplexus or Calophyllum.

Sowerby, *Mineral Conchology*, i, 165, pl. 72. Phillips, *Palæozoic Fossils*, p. 7, pl. 3, fig. 8. Michelin, *Icon. Zoophyt.*, 104, pl. 26, fig. 1. Michelin's genus is thus characterized by him: Fixum, glomerato-globosum vel ramosum, tubulosum; superficie cellis immersis; cellis sparsis, per diaphragmata transversa divisis, distinctis, obsoletè stellatis; lamellis subnullis. The species referred to the genus is from the Oolite.

Genus 4. Canina, *Michelin.* Quite simple or aggregato-gemmate. Corallum within transversely septate; cells concave; one or more rays of the star on one side obsolete, and the transverse septa beneath this part having a funnel-shaped depression; general texture like that of the Calophylla.

This genus, instituted by Michelin, includes a few species of Cyathophylla with a depression on one side of the star, and some appearance like a siphuncle. The depression is apparent in all the transverse septa below. Koninck doubts the grounds on which the genus is founded; but Michelin states that he has observed the characteristic in a large number of specimens. Good drawings of it are given in his *Iconographie Zoophytologique*, pl. 16. This peculiarity has not been observed in any massive species.

Genus 5. Acervularia, *Schweigger.* Ramose or aggregate. Corallum imperfectly transverse septate, or not at all so; cells acervately proliferous.

The Acervulariæ have a small cup-like cell, prominent within the summit and forming its centre, and are very proliferous from the summits. The characters of the genus require more study before it can be considered as established on sufficient grounds.

This genus was instituted by Schweigger for the species figured by Fougt in the Amœnitates Academicæ, (Corall. Balt., i, tab. 4, fig. 9, and No. 2,) and thus described by him: "Madrepora composita, corporibus proliferis e centro pluribus, undique coadunatis; stella convexa, centro concava." The genus is characterized as follows by Schweigger, (Handbuch, p. 418:) "Stirps calcarea, e conis approximatis: coni e cellulis lamellosis acervati omnes cellula terminali medio protracta, e centro depresso prolifera;" which may be translated: Calcareous, and made up of approximate cones; cones acervate and proceeding from lamellate cells, which have a terminal cell at middle, and are proliferous from this depressed centre. He names the species *A. baltica*. The essential characters of Schweigger's genus are retained in the above generic description. The convexity of the summit exterior to the cup-like centre, is not a universal character. The *Astræa ananas*, figured by Lonsdale, (Silurian System, pl. 16, fig. 6,) appears to belong to this group as here characterized; but his *Acervularia baltica*, which differs from Schweigger's, is the type of another genus.

The *Strombodes* of Schweigger may also fall in part into this genus. The peculiar structure attributed to the species, the formation of successive *layers* of cells, appears not to be of generic importance. He thus characterizes the genus: "Stirps calcarea, e cellulis lamellosis in conos acervatis, strata horizontalia constituentes. Coni paralleli, e cellula cyathiformi prolifera." (Handbuch, p. 418; see also Goldfuss, Petrefakten, 62, pl. 21.) The name is from στρομβος, *a top*, and refers to the inverted cones constituting the layers. Blainville changes the name to Strombastræa, (Man. d'Actinologie, p. 376.) The Strombodes of Ehrenberg includes those *solitary* Cyathophylla of Goldfuss, which from their peculiar interrupted mode of growth appear to consist of a series of inverted cones, ("tanquam conis e centro proliferis.") The species "Ringel-Coralle," pass so gradually into others, with a nearly smooth exterior, that the character can hardly be considered as of sufficient importance for founding a genus. Ehrenberg includes in his genus a recent species from the Red Sea, which I have referred to under Euphyllia.

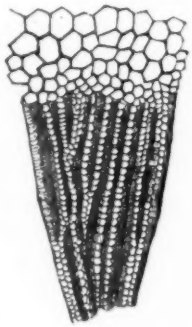
Lonsdale and Phillips apply the name Strombodes to species which have the lamellæ twisted about the centre, deriving the name from στρεφω, to *twist*, thus departing widely from the original signification of the word and genus, as introduced by Schweigger, (Pal. Fossils, p. 10; Sil. System, 691, pl. 16 *bis*, fig. 4.) If the genus or its name merits

a place in the science, Schweigger's characteristics of it should be to some extent retained.

Genus 6. ARACHNOPHYLLUM, *Dana.* Aggregate Cyathophyllidæ, having the cells faintly radiate, (the rays often obsolete towards the margin;) texture of the corallum for the most part cellular; of the radiating lamellæ, very minutely cellular.

This genus includes the *Acervularia baltica* of Lonsdale. The faint rays and the general texture seem to show a relation to the Cystiophylla. The rays under a microscope appear very delicately cellular, like the finest lace-work, instead of being solid plates, as is shown in the annexed cut, representing part of a section much enlarged. The stars, or separate polyps of a zoophyte, are usually without prescribed limits in the interior of the corallum. (Sil. System, pl. 16, fig. 8 to 8*e*; Schweig., Handb., p. 418.)

Fig. 1.



The absence, on a polished transverse section, of circumscribed limits to the stars, which appears to be a general characteristic, shows some relation to the Fungidæ, and the species may prove to belong to the tribe Astræacea; yet it is probable that the polyps were prominent as in the Porites, and that the budding was lateral or inferior, instead of superior. The texture below the centre of a cell is very imperfectly, if at all, transversely septate.

Genus 7. CYSTIOPHYLLUM, *Lonsdale.* Quite simple or ramose Cyathophyllidæ. Corallum not radiate, or rarely with distinct rays about the central area; texture of the sides, and usually of the whole corallum, spumoso-cellular.

The peculiar cellular structure of these species may at once be detected in the character of the lateral surface, especially after polishing off the exterior, if not before, when the cellules will be found to differ strikingly from the rectangular cellules of the Cyathophylla.

The species are usually without rays to the cells; yet in some, faint lines may be perceived around the central area, and a transition may be thus traced to the Cyathophyllum structure. The absence of transverse septa along the middle of the corallum has been laid down as a characteristic of the genus, yet it is not universal; and we perceive here, also, progressive transitions towards the Cyathophylla.

II. *Transverse septa converging upward into an axial line.*

Genus 8. Clisiophyllum, *Dana.* Quite simple, ramose or aggregato-glomerate. Corallum having the cells radiate; texture internally at middle consisting of septa and cellules converging upward, but without a distinct axis; texture exterior to this middle portion cellular.

This genus includes many of the so-called Cyathophylla, both simple and massive species. In internal structure they resemble the Micheliniæ, but differ in having the structure small cellular exterior to the central convergent portion. The bottom of the cell has usually a pointed conical prominence, proceeding from the character of the septa within; and about this centre the lamellæ sometimes appear twisted. These species with twisted lamellæ may constitute, in part, the genus Strombodes, as this name is used by Phillips and Lonsdale. The name is from the Greek *κλισιον, a tent*, and alludes to the ∧-like figures which are made by the converging lamellæ about the centre, as seen in a vertical section. The first of the annexed figures represents a simple turbinate species, resembling externally the Cyathophylla. The other (fig. 3.) is from a massive Astræoid species.

Fig. 2.

Fig. 3.

Genus 9. Michelinia, *Koninck.* Aggregate Cyathophyllidæ. Corallum with excavate cells; texture of the whole interior characterized by oblique irregular septa, converging upward toward an axial line; axis none.

This genus was instituted by Koninck. The species have the internal structure of the Clisiophylla, except that there is no regularly cellular structure exterior to the central convergent portion. They differ from the Sarcinulæ in having no axis. In the Michelinia tenuisepta (Calamopora tenuisepta of Phillips) the general structure of the corallum is columnar.

Phillips, *Geol. of Yorkshire*, ii, 201, pl. 2, fig. 30; Koninck, *Desc. des Anim. foss. des terrains houillers de Belgique*, 31, pl. C, figs. 3*a*, 3*b*; Michelin, *Icon. Zoophyt.*, 83, pl. 16, fig. 3.

Genus 10. Columnaria, *Goldfuss.* Glomerate; polyps laterally in contact, and consequently prismatic. Corallum having the cells radiate, texture internally at middle consisting of oblique septa and cellules converging upward into an axis; texture exterior to this middle portion, cellular.

In a transverse section of the Columnariæ, the outer portions are cellular, as in the Cyathophylla and Clisiophylla, while the inner consist of oblique septa converging upward into an axis; and this axis appears sometimes to be made by a convolution of the septa, or their partial coalescence. Excepting the existence of an axis, the species are similar in their essential characters to the Clisiophylla. The columnar forms into which the coralla break, by a separation of the prismatic cells, are supposed to characterize all the species of the genus; yet as this is not necessarily of generic importance, it may prove otherwise.

Fig. 4.

The genus Columnaria, as given in treatises, comprises, besides the species here included, some that have the internal structure of the Cyathophylla, an error which has arisen from allowing too much importance to mere aggregation and external form. The character of the axis in some species is noticed by Fleming, Parkinson, Blainville, and others. The *Lithostrotion* of Llwyd is synonymous with the Columnaria of authors. The name is of prior date, but, besides its imperfect application—meaning a *stone pavement*—it was given previous to the Linnæan period without reference to system, and is therefore not entitled to authority.

Goldfuss, *Petref.*, 71, pl. 24; Blainville, *Man.*, 350; Llwyd, *Lithophyllacii Britannici Iconographia*, Epist. v, tab. 23, Lithostrotion. Also Fleming's *Brit. Animals*, 508, and Parkinson's *Organic Remains*, ii, pl. 5, figs. 3 and 6.

Genus 11. Sarcinula, *Lamarck.* Cespitose or fasciculate Cyathophyllidæ; stems cylindrical. Corallum having the cells multiradiate; internal septa oblique upward, and extending quite from the sides; axis distinct.

The internal texture in this genus, as seen in a transverse section, is quite open, without dissepiments, excepting the oblique septa which occupy the whole interior, and appear like a series of inverted cones traversed by a central axis, (see annexed figure.) The species are closely related to the Columnariæ; the principal difference consists in the extension of the septa quite across the interior to the sides, and the consequent absence of the exterior cellular texture; the septa moreover are more regular, and sometimes seem to constitute each a simple plate. The species have some

Fig. 5.

resemblance to the Stylinæ and Caryophylliæ, but differ in internal structure.

This genus was instituted by Lamarck for a few unlike species, characterized by consisting of parallel stems or tubes, and has been retained in treatises with the same indefinite characteristics. The Madrepora organum of Linnæus is best determined, and appears entitled to rank as the type of the genus, and has been so considered in this place. The characters have been drawn from the figures by Fougt and Schweigger, and from a specimen examined by the author. Other cylindrical fossil species, similar in external habit, belong to the genera Amplexus, Cyathophyllum, or some one of the preceding groups.

Fougt, *Amæn. Acad.*, i, tab. 4, fig. 6, and No. 1; Schweigger, *Beobacht.*, pl. 7, fig. 66, and *Handb.*, 419; Lamarck, 2d ed., ii, 340; Blainville, *Man.*, 348; Goldfuss, *Petrefakten*, tab. 74.

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ART. IV.—*On the Chemical Composition of the Calcareous Corals;* by B. SILLIMAN, Jr.*

THIS article is from the work on Zoophytes, by J. D. DANA,† for which the researches were undertaken. This volume is just out of press, but can hardly be said to have been *published*, since the small number of copies printed (only *two hundred*) will enable very few even of those most interested ever to see the work. The investigations have led to some unexpected results, which will be found to have an important bearing on the subject of geology; especially as serving to explain in a more rational way than any heretofore offered, the origin of those rarer ingredients in metamorphic limestones and other rocks of animal derivation; which have always been a puzzle to geologists.

No extended researches on the chemical constitution of corals have been made, it is believed, since Mr. Hatchett's, already cited by Mr. Dana. This chemist did not operate *quantitatively*

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* In Vol. XLVII, p. 135, of this Journal, some earlier results obtained by me on this subject were stated, which were prematurely published, and greatly erroneous. The best antidote to an error of this sort is the early publication of correct and trustworthy results. It is to be hoped that the researches detailed in this paper are of this description, and the attention of those interested in such studies is invited to the repetition of the analyses here given. The geological interest of these observations is not in any way lessened by the results recently obtained, although differing so much from those previously published.—S.

† See *ante*, page 178, for the title, &c.

on any of the species examined by him; and his investigations tended to show that the calcareous corals, as well as the coverings of most of the molluscs experimented upon, consisted merely of carbonate of lime. Such was the opinion with which these chemical examinations were commenced. But while they have found carbonate of lime to be the principal ingredient, other elements have been detected, showing that coral is far from being the simple calcareous material supposed.

The following is a list of the species examined, which are here numbered for the convenience of reference:

1. Porites favosa, Sandwich Islands.
2. P. nigrescens, Feejees.
3. P. limosa, Feejees.
4. P. cylindrica, Feejees.
5. P. fragosa, Feejees.
6. Porites,* Paumotu.
7. Porites,* Wakes Island.
8. Porites,* Wakes Island.
9. Madrepora palmata, West Indies.
10. M. spicifera, Ceylon.
11. M. prolifera, Bermuda.
12. M. plantaginea, Ceylon.
13. M. cytherea, Tahiti.
14. Madrepora, Feejees.
15. Madrepora, Feejees.
16. Madrepora, Feejees.
17. Madrepora, Feejees.
18. M. cyclopea, Wakes Island.
19. Pocillopora damicornis, Sooloo.
20. P. elongata, Ceylon.
21. P. grandis, Feejees.
22. P. ligulata, Sandwich Islands.
23. P. cespitosa, Sandwich Islands.
24. Millepora tortuosa, Feejees.
25. Heliopora cærulea, East Indies.
26. Gemmipora brassica, Feejees.
27. Dendrophyllia nigrescens, Feejees.
28. Meandrina phrygia, Ceylon.
29. Astræa orion, Ceylon.
30. Astræa, (p. 721, pl. 13, fig. 15.)†
31. Astræa, Wakes Island.
32. Astræa, Wakes Island.
33. Astræa, Feejees.
34. Astræa, Feejees.
35. Astræa, Feejees.
36. Shell of Chama.

Nine of the above species, of which there was the largest quantity on hand, were selected for a minute determination of each ingredient, while of the others, only the proportion of carbonate of lime and animal matter to the other ingredients, was determined. The following are the nine selected:

I. Porites favosa (No. 1), Sandwich Islands.
II. Madrepora palmata (No. 9), West Indies.
III. Madrepora spicifera (No. 10), Ceylon.
IV. Madrepora prolifera (No. 11), Bermudas.
V. Madrepora plantaginea (No. 12), Ceylon.
VI. Pocillopora ligulata (No. 22), Sandwich Islands.
VII. Meandrina phrygia (No. 28), Ceylon.
VIII. Astræa orion (No. 29), Ceylon.
IX. Astræa (No. 30, p. 721, pl. 13, fig. 15.)

* Worn specimens, not identified. † The references are to Mr. Dana's work.

A few remarks are added upon some of their physical characters, before giving the mode and results of analysis.

*Hardness.*—All the various corals examined were superior in hardness to calcareous spar or common marble, and not inferior to Arragonite; while some were as hard as apatite or crystallized phosphate of lime; or according to the scale used by mineralogists, the usual hardness will be expressed by 4, though occasionally as high as 5. Using an iron mortar in the earliest trials, the iron pestle was roughened and cut under the resistance of the angular masses of coral, to a degree quite remarkable considering the nature of the substance operated on. So much iron was communicated to the powder from this source, that recourse was had to a mortar of porcelain, and even this was not proof against wear, the porcelain pestle being pitted by the repeated blows. The more porous species were crushed of course with less difficulty; and this was especially the case with the species of Porites.*

*Specific gravity.*—The specimens were reduced to fine powder before trying the specific gravity, as the porous character of the coral would otherwise interfere with obtaining correct results. Considerable variation will be observed in the following table. The numbers correspond to the catalogue on page 190.

| Specimens. | Sp. Grav. | Specimens. | Sp. Grav. | Specimens. | Sp. Grav. |
|---|---|---|---|---|---|
| No. 1 | 2·817 | No. 20 | 2·217 | No. 31 | 2·688 |
| 3 | 2·732 | 22 | 2·564 | 33 | 2·500 |
| 4 | 2·564 | 23 | 2·353 | 34 | 2·500 |
| 9 | 2·421 | 25 | 2·578 | Meand. rustica, | 2·571 |
| 10 | 2·105 | 26 | 2·584 | | |
| 12 | 2·427 | 27 | 2·740 | Shell of Chama, | 2·857 |

* On this subject Mr. Dana remarks, p. 711:—"The hardness of these coral secretions, which is much above that of common carbonate of lime, as stated by Mr. Silliman, is not fully explained by the peculiar chemical composition detected by this chemist. We suggest, as one cause, that the calcareous portion may have, in its intimate texture, the structure of Arragonite, or prismatic carbonate of lime, instead of that of common rhombohedral calc spar. The Arragonite structure has been shown to be due to crystallization at a higher temperature than that which is required for calc spar, the two minerals being identical in composition: in consequence of this higher temperature, a different crystalline form is assumed; and, moreover, the material has a higher degree of hardness, that of Arragonite being designated by 3½ to 4, while common calc spar or rhombohedral carbonate of lime is 3. These remarks, it will be perceived, bear upon the internal calcareous secretions of other animals. In connexion, it should be observed, however, that distinct rhombohedrons of *calc spar* have been detected by Mr. Carpenter in the shells of some Molluscs."

The average from the sixteen species of corals is 2·523.

*Color.*—In general the color of the specimens examined was white, or nearly so; but some of them, as the Dendrophyllia nigrescens, and blue Heliopora (H. cerulea) were highly colored. The coloring matter, in all cases, proved to be organic, and was usually due to some trace of the animal tissues. The highly colored ones, when powdered, burnt white, giving out, at a red heat, the odor of animal matter. The Heliopora dissolved in chlorohydric acid, without having its color altered, and gave a light indigo-blue solution. A drop of nitric acid, however, discharged this color, and ammonia threw it down as a brown precipitate. Heat immediately destroys it. It is, therefore, evident that the coloring matter is entirely organic, and is in no way connected with the mineral constitution of the coral. However, some corals have a slight ferruginous tint, from the presence of a little peroxyd of iron, which will be seen to be an almost constant constituent, although in exceedingly small quantity.

*Behavior with reagents.*—All corals are rapidly dissolved in dilute chlorohydric, nitric, or acetic acids, with brisk effervescence and escape of carbonic acid. The solution is frequently colored by organic matter, which sometimes renders it turbid. When the powdered coral is treated with pure water, more or less of common salt and other soluble saline matters, derived from the evaporation of sea water, are washed out, and this precaution was found necessary to insure accurate results.

The solution of a coral in nitric acid is very soon blackened by a solution of *nitrate of silver*, from the presence of organic matter. Ammonia, added to a solution in nitric or chlorohydric acid, with the least possible excess of acid, will generally produce an immediate precipitate of granular ammonio-phosphate of magnesia, thus indicating the presence of both magnesia and phosphoric acid.

Chloride of barium produces, with a chlorohydric solution, a granular, white precipitate, which is nearly all redissolved in an excess of chlorohydric acid. (A small portion of sulphate of barytes is generally formed in using this test, owing to the almost constant presence of a small quantity of sulphate of lime in the corals.)

A portion, dissolved in nitric acid, and carefully neutralized, when treated with nitrate of silver, will, on standing, deposit a

considerable yellowish precipitate of phosphate of silver, which is redissolved in ammonia and nitric acid.

Acetate of lead, added to a chlorohydric solution, produces a copious precipitate of chloride of lead, which is not wholly redissolved by an excess of acetic acid, but is taken up by nitric acid. These facts are a sufficient proof of the presence of phosphoric acid.

Lime-water, added to a solution of coral, either neutral or slightly acid, will produce an immediate gelatinous precipitate of all the bases and acids which the coral can contain, except, of course, the lime and solvent acid. Great care is needed in this operation to prevent the formation of a carbonate of lime; the solution should have been recently boiled, and the test applied while it is yet hot, the air being excluded; and the precipitate should be immediately collected on a filter and washed. If the precipitate by lime-water be fused in a platinum capsule, with carbonate of soda, or carbonate of potassa in excess, the phosphoric acid is all transferred to an equivalent portion of alkaline base, while the lime or magnesia, or the base with which it was before united, will remain as a carbonate. The usual tests, which have already been enumerated, will show the presence of the phosphoric acid.

The *lime-water* test offers far the best means of separating from the lime (which exists as a carbonate) all the other constituents of a coral, as these various substances are in very small quantity compared with the entire mass of the coral. Some easy means of completely separating them all, is an indispensable preliminary step in their examination and estimation.

I am indebted to my friend Dr. J. L. Smith, of Charleston, South Carolina, for suggesting to me the use of this test in the analysis of the corals.

As the several elements whose presence our researches have determined in corals, have been enumerated in the body of the work (p. 57), it is not necessary to repeat them here; but we may state, in a summary manner, an outline of the general course of analysis pursued in determining the constitution of the *lime-water precipitate*, which it will be allowed contains several elements whose association has always been considered as offering some of the most difficult problems in the whole range of inorganic analysis. The following plan of analysis has been con-

trived in part from the late researches of von Rammelsberg, on the estimation of phosphoric acid, and partly from the labors of Rose and Berzelius, adapting the method to the requirements of the particular problem before us.

A. The lime-water precipitate, after ignition, is weighed and then digested in fine powder in cold chlorohydric acid; it slowly dissolves, leaving a white flocculent powder. This collected and washed, will be found to be *silica*. It is harsh and gritty between the teeth, is not taken up by long digestion in strong acids, dissolves in a solution of caustic potassa, and before the blowpipe forms a hard colorless glass with carbonate of soda, dissolving in this reagent with effervescence.

B. The solution in chlorohydric acid is supersaturated with caustic ammonia, and boiled; a gelatinous precipitate separates, which is usually colored by iron, and by its characters indicates the presence of alumina. This precipitate contains the phosphoric and other acids, and the bases therewith combined. It is collected, and the filtrate therefrom (C) is examined for *lime* and *magnesia*, both of which are usually present.

D. The precipitate by ammonia (B) is next made into a thick paste with strong sulphuric acid, in a small vessel of platina. A plate of glass coated with wax and written on, is placed over the crucible; and heat being applied, *hydrofluoric acid* escapes, and attacking the glass, leaves a permanent record of its presence. I have never failed to obtain evidence of the presence of fluorine in any coral which has been subjected to the test. Generally, exposure for one minute will etch the glass most decidedly; and one experiment will suffice to mark distinctly several pieces of glass. By this plan of analysis the quantity of fluorine cannot be estimated, and it must be judged of either by the loss or by the deficiency of acids to satisfy all the bases formed. The constant association of phosphoric acid and fluorine, renders it advisable, in compounds in nature, where one of these elements is found, to search for the other.

E. After the sulphuric acid has been digested on (D) long enough to convert all the bases present into sulphates, a portion of bisulphate of potash or caustic potash is added, and a little water, to dissolve it; to this, a very large quantity of alcohol, of a specific gravity of about ·860, is added, and the whole is allowed to stand for some hours; during which the double sulphates of

potassa, alumina and iron, crystallize out, while any lime previously combined is separated as sulphate; and in the solution we must look for the phosphoric acid and magnesia, together with a little persalt of iron, held up by the alcohol.

F. The mixture (E) being filtered, and the precipitate washed quite clean with alcohol, the filtrate is evaporated until all the alcohol is expelled, and then supersaturated with ammonia; a little trace of alumina and iron separates, which may be added to that to be obtained from the other portion (H). We may now either add an excess of pure chloride of calcium to the filtrate (F), or a portion of perchloride of iron. The object in either case is to separate the phosphoric acid in combination with a base, from whose weight its quantity may be directly estimated, which is an indispensable step, since the fluorine, according to this plan of analysis, can be estimated only by the amount required to saturate the excess of bases. In case the chloride of calcium is employed, we have all the phosphoric acid in the form of phosphate of lime, mixed with a large quantity of sulphate of lime, derived from the sulphuric acid and sulphate of potassa previously employed. This mixture of phosphate and sulphate of lime is collected, washed, and redissolved in chlorohydric acid. The sulphate of lime is separated by alcohol, and the phosphoric acid remains in solution, which, after the excess of alcohol has been expelled, may be thrown down by ammonia, ignited and weighed, or preferably, may be estimated by a magnesian salt. If we employ the method by perchloride of iron, we form in the acid solution containing the phosphoric acid, a basic perphosphate of iron, on supersaturating the solution with ammonia. This compound is mixed with a bulky mass of peroxide of iron, which being thrown on a filter and thoroughly washed, is subsequently decomposed completely by hydrosulphuret of ammonia, into sulphuret of iron and phosphate of ammonia. Care must be taken to use a sufficient quantity of perchloride of iron, otherwise a white precipitate of neutral perphosphate of iron is formed, which is soluble in an excess of ammonia. In either case (the employment of the chloride of calcium, or the perchloride of iron) the phosphoric acid eliminated may be finally best estimated by a magnesian salt and ammonia, as the ammonio-phosphate of magnesia, from whose known constitution the phosphoric acid is easily calculated. We have employed both of these methods; but on many accounts prefer that by the perchloride of iron.

G. The alcoholic filtrate from (F), containing magnesia and lime, is treated by the well known methods of analysis for the estimation of those substances. The lime in all cases in these researches, was converted into sulphate and precipitated by alcohol. The magnesia was estimated as phosphate.

H. The crystalline precipitate from (F), which was collected on the filter, contained the alumina and iron, previously in combination with phosphoric acid or fluorine. This precipitate is boiled in a capsule with a strong solution of carbonate of soda, to decompose the sulphate of lime; it is then filtered, the insoluble residue washed thoroughly and treated with chlorohydric acid, the precipitate by ammonia from (F) being added, and the whole treated with excess of ammonia. Alumina and iron fall, which may be afterward separated in the usual way; but this was generally not deemed requisite, the quantity of iron being very small in most cases.

I. The filtrate from (H) is treated for lime by oxalate of ammonia, and the oxalate converted into sulphate and weighed: this dose of lime had been previously united to phosphoric acid or fluorine.

J. Magnesia is next separated from the filtrate of (I), by ammonia and phosphate of soda.

K. The alkaline liquor from (H) contains another portion of magnesia, which is separated in like manner as the ammoniophosphate. Much labor is saved if we take care to reserve the several portions, from which magnesia has been thrown down, and unite them in one filtration and weighing, instead of treating them as so many separate portions.

The minute determination of all the constituents of the lime-water precipitate, was attempted only on those specimens of which we had a large quantity at command; for a solution of half a pound or more of the coral in nitric or chlorohydric acid, was necessary to afford sufficient precipitate for analysis. The carbonate of lime, by far the most abundant constituent, was separately determined on one gramme, as sulphate of lime, and from this the carbonate was calculated. The ratio of phosphates and fluorides of the several bases to the entire mass was also determined from a distinct portion of coral, two grammes by weight; and from the data thus furnished, we have the means of safely estimating the organic matter by the loss.

*Organic matter.*—This constituent of the corals deserves particular notice. Some remarks have already been made on it, when speaking of the coloring matter of corals. This organic matter is so intimately united throughout the whole structure of the corals, amounting to 4 to 8 per cent., that it cannot be separated by any method resorted to, except by repeated deflagrations with the nitrate of ammonia. When reduced to the finest impalpable powder, it may be digested in repeated doses of boiling water, until no trace of organic matter is longer found in the water; and yet a careful analysis, by falling short of the amount required to complete the 100 parts, will invariably show its presence. The oxalate of lime obtained in their analysis, if ignited, (as in the usual manner directed for the estimation of lime,) will always have a dark carbonaceous hue, derived from the organic matter of the coral.

During the solution of considerable quantities of several corals, whose analyses are given beyond, (particularly in No. IV, but more or less in all,) a large quantity of fatty (?) matter separated, of a yellow color and disagreeable penetrating odor, though not fetid. It was easily seen floating on the surface of the solution, in transparent jelly-like masses of a yellowish color. It was insoluble in alcohol, but readily so in cold ether, and the evaporation of its ethereal solution yielded a yellow solid, resembling wax. It fuses below 200° F. A pungent irritating odor arose from the evaporation of the ethereal solution near its close, which acted powerfully on the eyes and nostrils. This volatile principle may be analogous to that known to proceed from the decomposition of fat, (acrolein?) It deserves more attention than I have been able to give it, particularly as it may perhaps be the source of the disagreeable odor of some limestones of coral origin.

*Analyses.*—The following tables exhibit a comprehensive view of the results of the several analyses. The relative proportions of organic matter, carbonate of lime, and the complex precipitate of phosphates and fluorides thrown down by lime-water, are first given; and afterwards the definite composition of this precipitate in the nine species more minutely investigated.

| | Porites. No. 1 (I). | Porites. No. 3. | Porites. No. 4. | Porites. No. 5. | Porites. No. 6. |
|---|---|---|---|---|---|
| Carbonate of lime, | 95·84 | 94·412 | 94·807 | 93·875 | 89·864 |
| Phosphates and fluorides, | 2·05 | 0·900 | 0·950 | 1·561 | 0.700 |
| Organic matter, | 2·11 | 4·688 | 4·243 | 4·564 | 9·431 |

| | Porites. No. 7. | Porites. No. 8. | Madrepora. No. 9 (II). | Madrepora. No. 10 (III). | Madrepora. No. 11 (IV). |
|---|---|---|---|---|---|
| Carbonate of lime, | 94·438 | 95·000 | 94·807 | 92·815 | 95·086 |
| Phosphates and fluorides, | 2·100 | 1·650 | 0·745 | 0·600 | 0·300 |
| Organic matter, | 3·462 | 3·350 | 4·448 | 6·585 | 4·614 |

| | Madrepora. No. 12 (V). | Madrepora. No. 14. | Madrepora. No. 15. | Madrepora. No. 16. | Madrepora. No. 17. |
|---|---|---|---|---|---|
| Carbonate of lime, | 94·881 | 93·297 | 94·143 | 94·239 | 93·59 |
| Phosphates and fluorides, | 0·710 | 2·450 | 0·900 | 0·500 | 0·50 |
| Organic matter, | 4·409 | 4·253 | 4·957 | 5·261 | 5·91 |

| | Pocillopora. No. 19. | Pocillopora. No. 20. | Pocillopora. No. 21. | Pocillopora. No. 22 (VI). | Pocillopora. No. 23. |
|---|---|---|---|---|---|
| Carbonate of lime, | 94·659 | 93·60 | 95·001 | 93·848 | 94·583 |
| Phosphates and fluorides, | 0·550 | 1·90 | 1·450 | 0·550 | 1·050 |
| Organic matter, | 4·791 | 4·50 | 3·549 | 5·602 | 4·397 |

| | Millepora. No. 24. | Heliopora. No. 25. | Gemmipora. No. 26. | Meandrina. No. 28 (VII). | Astræa. No. 29 (VIII). |
|---|---|---|---|---|---|
| Carbonate of lime, | 94·226 | 95·545 | 92·751 | 93·559 | 96·471 |
| Phosphates and fluorides, | 1·200 | 1·000 | 1·500 | 0·910 | 0·802 |
| Organic matter, | 4·574 | 3·455 | 5·749 | 5·536 | 2·727 |

| | Astræa. No. 30 (IX). | Astræa. No. 31. | Astræa. No. 33. | Astræa. No. 34. | Astræa. No. 35. |
|---|---|---|---|---|---|
| Carbonate of lime, | 96·551 | 94·810 | 91·782 | 93·923 | 91·112 |
| Phosphates and fluorides, | 0·262 | 0·900 | 2·100 | 0·500 | 0·550 |
| Organic matter, | 3·187 | 4·290 | 6·118 | 5·577 | 8·338 |

A portion of the massive shell of a large Chama, treated in a similar manner, afforded for 100 parts the following result:

| | |
|---|---|
| Carbonate of lime, . . | 97·007 |
| Precipitate by lime-water, . . . | 2·600 |
| Organic matter, . . . . | 0·398 |

The amount of organic matter is here very small; while the precipitate by lime-water is large. The examination of other shells with reference to this point, would have been highly interesting, and had it fallen within the scope of these researches, the subject would have been farther investigated.

The per-centage of phosphates and fluorides in the above analyses, after excluding the organic matter, is as follows:

| Specimens. | Phosphates and Fluorides. | Specimens. | Phosphates and Fluorides. | Specimens | Phosphates and Fluorides. |
|---|---|---|---|---|---|
| No. 1 (I.) | 2·095 | No. 12 (V.) | 0·743 | No. 24 | 1·258 |
| 3 | 0·945 | 14 | 2·562 | 25 | 1·036 |
| 4 | 0·992 | 15 | 0·947 | 26 | 1·593 |
| 5 | 1·637 | 16 | 0·528 | 28 (VII.) | 0·964 |
| 6 | 0·774 | 17 | 0·537 | 29 (VIII.) | 0·825 |
| 7 | 2·177 | 19 | 0·578 | 30 (IX.) | 0·270 |
| 8 | 1·710 | 20 | 1·990 | 31 | 1·040 |
| 9 (II.) | 0·780 | 21 | 1·504 | 33 | 2·114 |
| 10 (III.) | 0·642 | 22 (VI.) | 0·583 | 34 | 0·529 |
| 11 (IV.) | 0·314 | 23 | 1·099 | 35 | 0·600 |

It now remains to give the constitution of the precipitate of fluorides and phosphates. The results annexed are calculated for a hundred parts of the precipitate.

| | I. | II. | III. | IV. | V. |
|---|---|---|---|---|---|
| Silica, | 22·00 | 12·5 | 13·50 | 10·32 | 23·74 |
| Lime, | 13·03 | 7·5 | 10·40 | 15·57 | 35·01 |
| Magnesia, | 7·66 | 4·2 | 1·63 | 38·49 | 1·35 |
| Fluoride of calcium, | 7·83 | 26·34 | 34·85 | 7·50 | 8·88 |
| Fluoride of magnesium, | 12·48 | 26·62 | 19·06 | 2·62 | 20·44 |
| Phosphate of magnesia, | 2·70 | 8·00 | 5·87 | 0·25 | 3·46 |
| Alumina (and iron), | 16·00 | 14·84 | 14·69 | 25·25 | 7·12 |
| Oxide of iron, | 18·30 | | | | |

| | VI. | | VII. | VIII. | IX. |
|---|---|---|---|---|---|
| Silica, | 5·35 | | 11·0 | 30·01 | 8·70 |
| Lime, | 7·17 | | 25·9 | 17·45 | 16·74 |
| Magnesia, | 0·49 | | 0·8 | 24·57 | 45·19 |
| Fluoride of calcium, | 4·05 | | 15·0 | 0·85 | 0·71 |
| Fluoride of magnesium, | Phosphate of lime, 4·25 | Fluoride of mag. | 23·2 | 4·31 | 2·34 |
| Phosphate of magnesia, | 16·30 | | 4·7 | 0·32 | 0·34 |
| Alumina (and iron), | 35·00 | | 19·4 | 22·49 | 25·97 |
| Oxide of iron, | 27·39 | | | | |

The foregoing results show that, contrary to the expectation when the research was commenced, the fluorine is present in much larger proportion than phosphoric acid. The silica exists in the coral in its soluble modification, and probably is united to the lime. The free magnesia existed as carbonate, and was thrown down as caustic magnesia by the lime-water. Some small portion of lime was probably thrown down as carbonate, in spite of every precaution to the contrary. Only in two or three instances, however, was there any effervescence on the addition of chlorohydric acid to redissolve it.

It need hardly be said that the existence in sea water of all the matters noted in these analyses, is a just inference; but this subject, as well as the important geological inferences which may be drawn from the results now presented, will be fully discussed on another occasion.

My warmest acknowledgments are due to my friends and pupils, Messrs. D. Olmsted, Jr. and T. S. Hunt, who have zealously aided me in the laborious parts of these investigations.

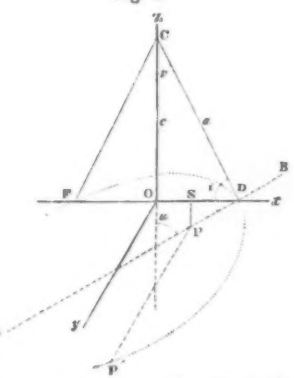
Yale College Laboratory, December 16th, 1845.

ART. V.—*Foci of Parabolas;* by GEORGE WATERMAN, Jr., A. M., Professor of Mathematics in Miami University.*

*The foci of all parabolas cut from a given cone by planes parallel to the same element, are in a right line passing through the vertex of the cone.*

Let $v$, (fig. 1,) represent the angle OCD formed by any element of the cone with its axis: assume the axis of $z$ as the axis of the cone; and let O be the origin of a system of rectangular coördinates. Representing the distance OC by $c$, the general equation of the conic surface will be of the form, $x^2+y^2=(z-c)^2 . \text{tang.}^2 v$.

Fig. 1.




If the cone be intersected by a plane AB, perpendicular to the plane $zx$, and making an acute angle with the axis $z$, it will cut out a curve, whose properties will vary with the relative position of the plane and axis.

Assume the point D, as the origin of a new system of coördinates, and represent these coördinates by $x'$, $y'$ and $z'$. Then for any point on the curve, as P′, we shall have $P'P=y'=y$. $PD=x'$. $PS=-z$. Represent the angle which the cutting plane AB makes with the axis of $z$, by $u$; the angle which the same plane makes with the extreme element CD by $i$; and the distance CD by $a$. We shall then have $OD=a\sin v$. $DS=x'\sin u$. $PS=-z=x'\cos u$. $OS=x=OD-DS=a\sin v-x'\sin u$; and $c=a\cos v$; or $x=a\sin v-x'\sin u$. $y=y'$, and $z=-x'\cos u$. Substituting these values in the general equation of the conic surface above, and reducing, we obtain for the intersection, $y'^2\cos v-2ax'\sin v\cos v\sin(u+v)+x'^2\sin(u+v)\sin(u-v)=0$. But since $i+u+v=180^\circ$, $u+v=180-i$, and $u-v=180-(i+2v)$. Hence

* Since the following communication was received, Prof. W. has accepted the appointment to the chair of Natural Philosophy and Astronomy in the Newton University, Baltimore; and ere this has probably entered upon its duties.

$\sin(u+v)=\sin i$, and $\sin(u-v)=\sin(i+2v)$. Substituting these values, and we find for the general equation of intersection,

$$y'^2\cos^2 v-2ax'\sin v\cos v\sin i+x'^2\sin i\sin(i+2v)=0.$$

If we make $i+v=180°-v$, or $i+2v=180°$, the plane AB will become parallel to the extreme element of the cone CF. Under this supposition $\sin i+\sin 2v$, and $\sin(i+2v)=0$. Introducing these values, and the equation of intersection becomes $y'^2\cos^2 v-2ax'\sin v\cos v\sin 2v=0$. But $\sin 2v=2\sin v\cos v$: hence $y'^2\cos^2 v-4ax'\sin^2 v\cos^2 v=0$; or $y'^2-4ax'\sin^2 v=0$; or finally, $y'^2=4ax'\sin^2 v$. But $a\sin v=$OD. Representing this by $r$, we have $y'^2=4r\sin v.x'$, or, omitting the accents of the variables, $y^2=4r\sin v.x$, which is the equation of the common parabola. In this equation, $4r\sin v$ is the parameter, and $r\sin v$ the distance from the vertex of the curve to the focus, which may be represented by $\frac{p}{2}$. Since $v$, and consequently the sine of $v$, is constant for the same cone, we may represent it by $b$. We shall then have $y^2=4brx$. But since $b$ is constant for the same cone, the distance from the vertex to the focus will vary with $r$.

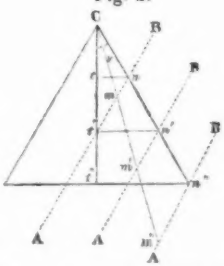
Making $r=0$, we find $\frac{p}{2}=0$.

" $r=1$, " " $\frac{p}{2}=b$.

" $r=2$, " " $\frac{p}{2}=2b$.

&c. &c.

Fig. 2.




If $mn$ (fig. 2,) be made equal to $b=\sin v$, we shall have from similar triangles, $Cn : tn :: Cn' : t'n' :: Cn'' : t''n''$, &c.; and $Cn : mn :: Cn' : m'n' :: Cn'' : m''n''$, &c. Hence, $tn : mn :: t'n' : m'n' :: t''n'' : m''n''$, &c. But $mn$ is the distance from the vertex to the focus of that parabola cut from the cone at the point where $tn=r=1$. If the spaces $Cn$, $nn'$, $n'n''$, &c. be made equal, we shall have for $t'n'=2tn$, $m'n'=2mn$, $m''n''=3mn$, &c. But when $tn=r$ is equal to zero, we have seen that $\frac{P}{2}=0$. Hence,

1st. When $r=0$, $\frac{P}{2}=0$, *or the focus is at the vertex of the cone.*

2d. *The line drawn through the vertex of the cone and the focus of any one parabola, will pass through the foci of all others cut from the same cone by planes parallel to the same element.*

If the line $Cm''$ be revolved around the axis of the cone, it will generate the surface of a new cone, which surface will be the locus of the foci of all the parabolas which can be cut from the given cone by planes parallel to *any* element.

Miami University, Oxford, (Ohio,) March 7, 1845.

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ART. VI.—*Abstract of a Meteorological Journal, for the year* 1845, *kept at Marietta, Ohio,* Lat. 39° 25′ N., Lon. 4° 28′ W. of Washington City; by S. P. HILDRETH, M. D.

| MONTHS. | THERMOMETER. | | | | | | BAROMETER. | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean temperature. | Maximum. | Minimum. | Fair days. | Cloudy days. | Rain and melted snow, in inches. | Prevailing winds. | Maximum. | Minimum. | Range. |
| January, - - | 37·10 | 58 | 22 | 10 | 21 | 2·58 | S. W., N. W. | 29·83 | 29·10 | ·73 |
| February, - | 38·33 | 70 | 8 | 18 | 10 | 1·50 | W., N. W. | 29·75 | 29·05 | ·70 |
| March, - - | 43·50 | 77 | 18 | 17 | 14 | 2·67 | N. W., N. | 29·80 | 29·08 | ·72 |
| April, - - | 58·47 | 89 | 15 | 23 | 7 | 2·50 | W., N. W., N. | 29·70 | 29·35 | ·35 |
| May, - - | 59·70 | 85 | 30 | 26 | 5 | 1·33 | N., N. W., S. W. | 29·76 | 29·38 | ·32 |
| June, - - | 69·74 | 90 | 44 | 17 | 13 | 6·55 | S. W., S. E. | 29·65 | 29·28 | ·37 |
| July, - - | 72·57 | 90 | 49 | 22 | 9 | 3·22 | S. W., N., N. W. | 29·55 | 29·20 | ·35 |
| August, - - | 71·17 | 90 | 52 | 23 | 8 | 2·00 | S. W., S. | 29·65 | 29·25 | ·40 |
| September, - | 63·90 | 84 | 40 | 21 | 9 | 4·38 | S. W., N. | 29·60 | 29·25 | ·35 |
| October, - - | 50·74 | 76 | 23 | 25 | 6 | 2·80 | S. W., N. | 29·96 | 29·25 | ·71 |
| November, - | 42·10 | 73 | 18 | 17 | 13 | 3·04 | S. W., W., N. W. | 29·80 | 29·12 | ·68 |
| December, - | 25·40 | 45 | −2 | 17 | 14 | 1·33 | W., N. W., N. | 29·72 | 29·18 | ·54 |
| Mean, | 52·73 | | | 236 | 129 | 33·90 | | | | |

*Remarks on the year* 1845.—The year which has just closed will long be remembered in the annals of Ohio, for the cold drying winds and late frosts which attended the spring months, and the excessive drouth of the summer; especially over the central and northern portions of the State. At Marietta, from the 10th of March to the 22d of April, there fell less than two-twelfths of an inch of rain; while the cold drying winds from the west and the northwest, served to evaporate, with great rapidity, the moisture which usually saturates the earth from the rains of the latter part of winter and early spring. The effect of these cold drying winds on the meadows and pastures was very injurious, checking the growth of the grasses and shrivelling their roots,

so that by the middle of May, there was little more appearance of vegetation than there usually is in the last of March. Farmers who had hay, fed their cattle the same as they do in winter; and the earth was not fairly soaked with rain until the middle of June. Repeated frosts continued to follow each other until the first of that month, cutting down and destroying the corn, potatoes and beans, three or four times in succession; so that most fields needed to be replanted and replowed two or three times, making it as late as the 5th of June when the last replanting took place. Early planted potatoes were nearly all ruined, yielding a crop but little larger in amount than the seed used. Wheat suffered excessively from the drouth and frosts. On the 9th of April, the mercury fell to 15° Fahr.; killing many fields of wheat, which the warmth of March had hurried forward in its growth earlier than usual. About the middle of June, the prospect for crops was very gloomy, and there was much fear that we should have a greater scarcity of food, both for man and beast, than was ever seen in Ohio. After that time, abundant rains set in through the southern portions of the State, and the wheat and corn revived in a wonderful manner; the former yielding a medium crop and the latter a pretty fair one. The meadows were too much exhausted by the drouth to recover their fertility, and the growth of hay was a great failure, yielding less than half the amount of usual years, and that of a very poor quality. The price of hay, which is commonly five or six dollars a ton, rose to ten or eleven in the farming districts, and to fifteen and eighteen in the cities. In addition to the other calamities of the season, the disease called "*the rot*," appeared among the potatoes, and destroyed large quantities of this valuable vegetable. What may be the ultimate result of this new scourge remains to be seen. It may continue to spread and increase in malignity, or more favorable seasons may put a check to it entirely. The late spring frosts were more destructive to the fruits than to the grain and grasses. Apples, pears, peaches, plums and cherries were an entire failure, except in a few favored spots, from Wheeling to Cincinnati, along the river and extending back to the vicinity of Lake Erie. Grapes, gooseberries and strawberries suffered in the same way, about Marietta. The first were all killed, except where protected by the warmth of a building, from the frosts in May. The season was very similar in this respect to that of the year 1834.

The mean temperature of the year 1845 was 52·73°, which is about the average for a series of years. The Author of nature has so arranged the seasons that the amount of heat in any one year does not materially differ from that of another, although to a careless observer it may seem not to be so. It is oftentimes distributed in a different manner; one spring being warmer than another, and one summer much cooler, thus causing an exceeding great variety in the seasons, all for wise and beneficent purposes. Yet amidst all this diversity, the wisdom of God is displayed in the exceeding regularity and certainty of the laws which govern the temperature of the year, not only in the same, but in different climates. "Summer and winter, seed-time and harvest," we are assured, shall regularly return so long as the earth continueth.

The amount of rain and melted snow was 33·90 inches, being about 6 inches less than the mean annual average for this climate. Here also the same beautiful laws which regulate the heat, govern the quantity of rain which is needed to supply the necessities of plants and animals, being nicely adapted to the moderate or rapid manner in which it is evaporated by the heat of the climate. In the cold regions of the north, a few inches supply all the wants of the vegetable kingdom; while in the tropics, it is poured down in torrents, amounting in some places to twelve or fourteen feet annually. Who but an atheist could fail, in this law, to see the guiding and directing hand of the great Architect of the Heavens.

*Winter.*—The mean temperature of the winter months was 36·60°, which is more than two degrees warmer than in 1844. The mercury was at no time down to zero; the coldest day being the 7th of February, when it fell to eight degrees above. The Ohio river was not frozen over, and steamboats continued to run all winter, with the exception of a few days about the 20th of December. No ice was formed of sufficient thickness for laying up in ice-houses, and only a scanty supply was procured from floating fragments in the Ohio, at the breaking up of the Allegheny, in February. The amount of snow was small, the greatest quantity at any one time being three inches, which was in December—it being remembered that in making up the temperature of a winter, this month is always attached to that of the following year, where it properly belongs.

*Spring.*—The mean temperature for the spring months was 53·89°, which is two degrees less than that of 1844, and nearly five less than that of 1842. The months of February and March were each nearly a degree warmer than those of 1844, and brought forth vegetation at a rapid rate, so that the garden crocus was in bloom by the 20th of the former month, and until the 20th of the latter, there was every prospect of an early and favorable spring, but after that time, the frequent frosts of April and May destroyed all the flattering prospects of the flower garden and orchard. The following floral calendar will show the progress of vegetation and the injuries which it sustained from the inclemency of the season.

*Floral calendar.*—February 11th, robin, Turdus migratorius, appears; 12th, blue-bird, Hirundo purpurea, seen; 20th, yellow crocus in bloom, honey bee at work; 24th, the earth is sufficiently dry and warm to plant onions, peas and potatoes.

March 5th, red elm and willow in bloom; 6th, Hepatica triloba in bloom; 10th, daffodil; 12th, apricot tree in bloom; 13th, early hyacinth; 19th, windy, with showers of snow; on the morning of the 22d, the mercury fell to 18°, which is several degrees lower than since the 7th of February; but there was frost nearly every morning from the 12th to the 29th of March; 29th, scarlet-colored Pyrus japonica in bloom; 30th, peach tree and crown imperial; 31st, streets dry and dusty—no rain for twenty one days.

April 2d, Italian narcissus in bloom; 3d, Sanguinaria canadensis; 5th, imperial gage; 6th, Mespilus arborea, June berry; 8th, cold wind—snow fell half an inch in the night—mercury at 22°; 9th, thermometer at 15° in the morning—all ended with a cold dry wind. Last night destroyed the blossoms and germs of nearly all the various kinds of fruit; also a vast many flowering buds of the tulip, which were just beginning to appear above the surface. Out of more than two thousand bulbs of this splendid flower, not more than sixty or eighty ever opened their petals. Several large plants of the Pæonia moutan, which is one of the most hardy of plants, suffered in the same way, although covered with mats; only one plant escaped, which was of the single variety, and was protected by being covered with a barrel. Peas three inches high were killed. 10th, on this day the great fire at Pittsburgh took place; 11th, Anemone virginiana; 12th, earth

very dry—plants dwarfish and sickly; 16th, cherry in bloom, but the germ is black and dead; 18th, apple tree in bloom, germ brown; 19th, primrose and cowslip; 20th, Ranunculus acris; 21st, vernal snow-drop; 22d, Anona glabra, or papaw—the fruit all killed, except in one sheltered spot, a few miles below, on the Ohio river; 24th, Trillium thalictroides—also black haw; 26th, Cornus florida in bloom. The Cercis ohioensis, or red-bud, which opens its beautiful purple blossoms at the same time with the Cornus, and affords such a rich contrast of color, is this year barren, being killed by the cold of the 9th. It is one of our most common forest ornaments, and is greatly missed. 27th, Claytonia and columbine; 28th, pea in bloom, from shoots thrown up since the 9th; 30th, single Pæonia moutan.

May 1st, Cineraria canadensis—double yellow rose; 2d, rose colored peony, herbaceous; 3d, purple mulberry; 8th, hard frost this morning, killing beans, corn and grape blossoms; 9th, Boursault rose in bloom; 10th, Rubus villosus—the frost destroyed nearly all the fruit of this full berry, which is a rare occurrence—black walnut; 11th, Robinia pseudacacia, which is thirteen days later than last year; 14th, Kalmia latifolia—this shrub bears transplanting well when in blossom; 15th, Maclura aurantiaca; 17th, Prunus virginiana—hard frost this morning; 19th, Magnolia tripetala; 24th, strawberry ripe—peas fit for the table; 25th, Syringa philadelphica; 26th, hard frost; 27th, Privet in bloom; 30th and 31st, frost on both these mornings—Seneca locust in bloom.

June 1st, rose bugs appear in thousands, and are very destructive to the blossoms of grapes, a few of which on the sides of buildings escaped the frosts; 2d, hardy roses generally in bloom; 6th, drouth very severe—pastures, meadows and corn perishing; 11th, Catalpa tree in bloom. After the 10th of this month there was an abundance of rain, six and a half inches falling by the end of the month. The effect on plants and vegetation was surprising, reviving the perishing wheat and corn in a few days to vigorous growth. 14th, Sambucus canadensis; 17th, black raspberry ripe; 18th, cucumbers fit for the table, protected under boxes; 23d, red and white Antwerp raspberry ripe, such as escaped the frosts; 30th, wheat harvest begins in early sown fields. Indian corn has grown so rapidly in the last fifteen days, that it looks nearly as well as in ordinary years.

Some fields were replanted three times. This grain can be planted from the first of April to the first of June in this climate, and make a crop.

July 1st, whortleberry ripe, being protected from frosts by the forest trees, among which they grow; 10th, chestnut tree in bloom; 16th, hay harvest begins, some weeks later than usual, and the crop is poor and thin.

*Summer.*—The mean temperature of the summer months was 71·16°, which is a little higher than that of 1844, and was favorable in this part of Ohio to vegetation. In June and July, there fell nearly as much rain as in the five preceding months, and produced a rapid growth in Indian corn, potatoes and oats. The wheat crop was a tolerable one, and the grain generally ripened well. Nearly all our summer fruits were destroyed, such as strawberries, gooseberries, currants, peaches and grapes. Melons, of both varieties, planted after the first of June, produced fine crops, and partly compensated for the loss of the fruit. Apples and pears were very scarce, and what few there were generally proved defective and rotted soon. For winter use, there were very few orchards that produced any, which was a serious loss to many farmers near Marietta, who put up annually for market from five hundred to two thousand barrels, of the choicest varieties.

*Autumn.*—The mean temperature of the autumnal months was 52·25°. This season was very pleasant while it continued, but terminated rather abruptly the latter part of November; the last nine days were quite cold, and the ground was covered with snow on the 30th. December commenced with great severity; on the morning of the first day, the snow which fell on the last night of November, was nine inches deep; and the morning of the 2d, the mercury sunk to zero. The rivers were filled with floating ice, and on the 5th day of December, the Ohio was frozen over, and the navigation of boats remained obstructed into January, 1846. The thermometer has been below zero on several mornings, and the season is thus far the coldest we have had for several years.

*A brief account of the drouth in the northern portion of Ohio, in the vicinity of Lake Erie.*—The district of country which suffered the most, was about one hundred miles in length and fifty or sixty in width, extending nearly east and west parallel

with the lake, and in some places directly bordering on the shore of this great inland sea. There was no rain from the last of March or the first of April, until the 10th of June, when there fell a little rain for one day, but no more until the 2d of July, when there probably fell half an inch, as it made the roads a little muddy. From this time, no more rain fell until early in September. This long continued drouth reduced the streams of water to mere rills, and many springs and wells heretofore unfailing became dry, or nearly so. The grass crop entirely failed, and through several counties the pasture grounds in places were so dry, that in walking across them the dust would rise under the feet, as in highways. So dry was the grass in meadows, that fires, when accidentally kindled, would run over them as over a stubble-field, and great caution was required to prevent damage from them. The crop of oats and corn was nearly destroyed. Many fields of wheat so perished that no attempt was made to harvest them. Scions set in the nursery, dried up for lack of sap in the stocks, and many of the forest trees withered, and all shed their leaves much earlier than usual. The health of the inhabitants was not materially affected, although much sickness was anticipated. Grasshoppers were multiplied exceedingly in many places, and destroyed every green thing that the drouth had spared, even to the thistles and elder tops by the roadside.

The late frosts and cold drying winds of the spring months, cut off nearly all the fruit, and what few apples remained, were defective at the core and decayed soon after being gathered in the fall. Many of the farmers sowed fields of turnips in August and September, hoping to raise winter food for their cattle, but the seed generally failed to vegetate for lack of moisture. So great was the scarcity of food for the domestic animals, that early in autumn large droves of cattle were sent into the valley of the Scioto, where the crops were more abundant, to pass the winter, while others were sent eastward into the borders of Pennsylvania. This region of country abounds in grasses, and one of the staple commodities is the produce of the dairy. Many stocks of dairy cows were broken up and dispersed, selling for only four or five dollars a head, as the cost of wintering would be more than their worth in the spring. Such great losses and suffering from the effects of drouth, has not been experienced in that portion of

Ohio for many years, if at all since the settlement of the country. As the lands become more completely cleared of the forest trees, dry summers will doubtless be more frequent. In a region so near a large body of water, we should expect more rain than in one at a distance. The sky in that district is, nevertheless, much oftener covered with clouds than in the southern portion of the State, where rains are more abundant; but the dividing ridge, or height of land between Lake Erie and the waters of the Ohio, lacks a range of high hills to attract the moisture from the clouds, and cause it to descend in showers of rain.

For the above account of the drouth in the "Western Reserve," I am under obligation to Seabury Ford, Esq., of Granger county.

Marietta, Ohio, January 8, 1846.

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ART. VII.—*Observations on the Eocene formation of the United States, with descriptions of species of Shells, &c. occurring in it;* by T. A. CONRAD,—(with two plates.)

SINCE I discovered the Eocene formation in Maryland in 1830, my own researches and those of others, have proved its wide extension in the southern and southwestern states, and I now propose to publish descriptions and illustrations of most of the organic remains of that formation in the pages of this Journal. The development of the Eocene is much greater than was supposed, in consequence of its embracing a white friable limestone, formerly referred to the upper cretaceous period. In reviewing the organic remains of that rock, I cannot resist the conviction that it is so nearly of the same age with the Eocene sands of Alabama, Mississippi, Louisiana, &c., that it may not with propriety be referred to an earlier era. The occurrence of what were supposed to be remains of Enaliosauri, now proved by Mr. Owen to be more of a cetaceous character; the genus Plagiostoma, Gryphæa vomer, (Morton,) and one or two other secondary forms, led me to believe that the limestone in question was a connecting link between the secondary and tertiary strata. But I now find the group of fossil genera to have so decided an affinity with that of the Eocene period, that I confidently class the whole white limestone of the southern parts of Alabama and Mississippi with the strata of that era. This limestone is extensively developed in Clarke Co., Alabama, where

the remains of Zeuglodon were found and transmitted to me in 1834, by Mr. Cooper, of Claiborne. Six miles west of Claiborne I examined this rock in the banks of a mill-stream and collected Scutella Rogersii, Pecten Poulsoni, and P. perplanus, &c. Between Claiborne and St. Stephens it forms hills of considerable elevation, and abounds in that fine fossil, Plagiostoma dumosum. At St. Stephens, on the Tombeckbee, this limestone constitutes an elevated bluff and abounds in Nummulites Mantelli, Plagiostoma dumosum, Ostrea cretacea, &c. At Vicksburg, the Pecten Poulsoni is common to this rock and to the Eocene sand, and the Zeuglodon was found on the Washita river in similar sand, as is proved by portions of the matrix adhering to the bone, with fragments of well known Claiborne fossils, and a perfect valve of Corbula oniscus. This gigantic animal therefore lived in a period when the limestone and sand were both deposited, and which are probably of contemporaneous origin.

The following is a list of the fossils I obtained from the Eocene limestone of Alabama and Mississippi: Zeuglodon, Owen, (Basilosaurus, Harlan,) Pecten Poulsoni, P. perplanus, P. elixatus, P. anatipes, P. calvatus, Modiola cretacea, Plagiostoma dumosum, Gryphæa vomer, Ostrea cretacea, O. panda, Nummulites Mantelli, Scutella Rogersii. Of these species, Ostrea cretacea, O. panda, and Gryphæa vomer, occur also in the cretaceous strata of New Jersey and Alabama. The fossils of the Carolina and Alabama limestones are figured and described by Dr. Morton in his Synopsis of the Organic Remains of the Cretaceous Formations.

The following species occur both in the Eocene of Paris and of Claiborne, &c. They were published, with the exception of Fusus longævus, in 1835, in the Tert. Foss., p. 34. Solarium patulum, *Lamk.*, S. canaliculatum, *Lamk.*, Bonellia terebellata, Sigaretus canaliculatus, *Sow.*, Calyptræa trochiformis, *Lamk.*, Pyrula tricarinata, *Lamk.*, Corbis lamellosa, *Lamk.*, Cardita planicosta, *Lamk.*, Fusus longævus, *Lamk.*

The last named shell was found by Professor Rogers and identified by myself with the Paris species. To the foregoing list may be added *Trochus agglutinans*, and *Lithodomus dactylus*, found by Lyell, in Georgia.

## Eocene Shells.

### Siliquaria.

The genus Siliquaria of Lamarck, is not of earlier origin than the Eocene period. The one species I have described is the only one hitherto discovered in this country, either recent or fossil. Chenu figures sixteen species, five of which are fossil in the tertiary strata of France. Deshayes enumerates five species in the Paris basin, (Eocene.)

Siliquaria vitis. Irregularly contorted, rounded, longitudinally striated; the striæ disappearing on the lower part of the shell; volutions more regular and approximate towards the apex, and the longitudinal striæ prominent; fissure inarticulated. (Plate I, fig. 1.)

*Siliquaria vitis*, Con.; Foss. Shells of Tert. Form., p. 36, Aug. 1833.

*S. claibornensis*, Lea, Cont. to Geol., Plate I, fig. 1, Dec. 1833. Chenu, Plate II, fig. 15.

Claiborne, Alabama.

This species is not uncommon, but it can only be obtained in fragments; it is much contorted, and I have seen it in the bluff more than twelve inches long. The volutions resemble those of S. anguina, and the longitudinal lines upon them are rather coarse and slightly prominent.

### Dentalium.

The genus Dentalium of Linnæus, has been observed in the Lias and great Oolite of England. In the United States it has not been found of older date than the Eocene period. Two species of that formation, and two of the Miocene, comprise all that have come under my observation. The Miocene, D. dentale, is identical with the recent shell which inhabits the coast of Massachusetts. I have not met with another recent species on the coasts of the United States, except a white, very slender and delicate one which is common on a part of the southern coast of Florida, and a single specimen of Ditrupa gadus, which came up on the lead in deep water in the Gulf of Mexico. This species is also a Miocene fossil in Virginia.

Dentalium thalloides. Slightly curved, most so towards the apex, where it is rather suddenly bent; ribs prominent, striæform, alternating with fine lines; the lines sometimes double; ribs most

prominent towards the apex, becoming obsolete near the base; aperture round. (Plate I, fig. 2.)

*Dentalium thalloides*, Con., Foss. Shells of Tert. Form., p. 34, August, 1833.

*D. alternatum*, Lea, Cont. to Geol., Plate I, fig. 2, Dec. 1833.

Claiborne, Alabama.

This species is abundant and very elegantly striated. It is delicately pointed and thin at base. In Chenu's splendid work there is an excellent figure of it.

Dentalium arciformis. Regularly curved, tapering very gradually, round, polished, very thick at the apex. (Plate I, fig. 3.)

Claiborne, Alabama.

I have but three imperfect specimens of this species, and they do not suffice to exhibit the complete outline of the shell. It is much more elongated and tapering than Lea's D. turritum, which I have not seen. The turrited form of the superior margin of the latter species is probably accidental, the result of fracture.

### Anguinella.

I propose this name for a genus resembling Serpula in external characters, but distinguished by its numerous internal vaulted septa, which are entire or enclose chambers without a channel of communication. I find two species only, one of which occurs in the Miocene of Virginia.

Anguinella ornata. Contorted, glomerated, with irregular transverse furrows and longitudinal unequal striæ, which are roughened by granulations, frequently obsolete. (Plate I, fig. 4.)

*Serpula ornata?* Lea, Cont. to Geol., Plate I, fig. 5.

*S. squamulosa*, Con., Journ. Acad. Nat. Sci., Vol. vii, p. 149.

Claiborne, Alabama.

This species is rare; it is occasionally convoluted, and when this is the case, one side is flattened, and attached to other specimens or to other shells, &c.

### Fistulana.

The genus Fistulana, Lam., has not been noticed in a formation below the Eocene strata, and there are few species in a fossil state. I have met with one only either recent or fossil as an American species. Deshayes has found six species in the Eocene of Paris.

Fistulana larva. Ovate-oblong, ventricose; thin and fragile; anterior margin short, straight, very oblique; extremity angula-

ted; posterior margin regularly rounded; ambonial slope defined by impressed lines; concentric lines on the anterior half of the shell rough and prominent; basal margin slightly arched. (Plate I, fig. 5.)

Claiborne, Alabama.

This rare species is allied to F. elongata, *Desh.*; but is proportionally shorter and very distinct.

### Balanus.

One species of this genus occurs in the Eocene limestone of South Carolina, and I know none of earlier date. The large Miocene Pectens are frequently covered with large and small species. Six recent Balani have been described as inhabitants of the Atlantic coast, of which, one only, B. ovularis, has been discovered in the miocene.

Balanus peregrinus. Subovate; valves longitudinally striated and obscurely sulcated transversely; the large valves curved towards the narrow end of the aperture; aperture large, acutely ovate. (Plate I, fig. 6.)

*Balanus peregrinus*, Morton; Synopsis of Organic Rem. of Cretac. Group, p. 72, Plate X, fig. 5.

Near Santee canal, South Carolina.

This shell is remarkably perfect and retains part of its original reddish color. I discovered it in white friable limestone, between Charleston and the Santee canal.

### Pholas.

The genus Pholas has been discovered by Sowerby and Phillips, in the coral rag, Kimmeridge clay and gault. The oldest species known in this country, is the one I found in the Eocene. There is one other species in the Miocene strata of Virginia. Deshayes enumerates nine in the European tertiaries, three of which belong to the Paris Eocene. We find five recent species on the coasts of the United States, two of which are limited to the southern coast.

Pholas petrosa. Ovate-acute; anteriorly profoundly ventricose, the extremity truncated, not very obliquely; posterior side cuneiform; surface with numerous acute unequal radii; dorsal margin declining, subrectilinear; basal margin nearly rectilinear. (Plate II, fig. 1.)

*Pholas petrosa*, Con.; Proceed. Nat. Inst., p. 193, Plate II, fig. 4.
Piscataway, Prince George's Co., Md.

Occurs in an indurated marl at the summit of the Eocene, and is rare and imperfect; generally in casts, with a trace of the shell remaining.

### Pholadomya.

I believe this interesting genus first appears in the Oolite group. Several species from rocks of that period have been described by Sowerby. M. Marcel de Serres described a species in the tertiary marls of the south of France, and one recent species has been figured and described by Sowerby in his "Genera of Shells." This inhabits the West Indies. In this country the oldest species we find is from the cretaceous strata. Two tertiary species have been described by myself; one belonging to the Eocene, the other to the Miocene period. The latter has been erroneously referred to Panopæa by Deshayes. From that genus it widely differs, in having a pearly nacre and in being destitute of cardinal teeth. The young or middle aged shells are extremely fragile, and have scarcely a trace of the muscular or palleal impressions, resembling in this respect, the recent species, with which the hinge also corresponds.

Pholadomya Marylandica. Ovate, profoundly ventricose, with coarse, irregular concentric lines and furrows, and obsolete, rather indistinct radii; umbo summit prominent; anterior side very short, the extremity subtruncated; basal margin rounded; posterior extremity rounded. (Plate I, fig. 9.)

*Pholadomya Marylandica*, Con.; Proceed. Nat. Inst., p. 193, Plate I, fig. 3.

Piscataway, Md.

This rare shell accompanies Pholas petrosa, and is in the same state of preservation. Little of the shell remains, and that exhibits the pearliness which no doubt characterized all the species, and which prominently distinguishes this genus from Panopæa.

### Panopæa.

The genus Panopæa, of Menard de la Groye, embraces few recent species. Sowerby has described one from the Great Oolite and another which is supposed to occur in the Green Sand formation. Deshayes enumerates three fossil species, one in the Eocene of Paris, the other in Miocene deposites. In this country, I find

one in the Eocene of Maryland, and four in Miocene strata. I once obtained a large recent species at Mobile Point, Alabama, which was lost before I had determined its relation to others. I have revisited this and the neighboring coasts without finding another specimen.

PANOPÆA ELONGATA. Ovate-oblong, ventricose, contracted from beak to base; posterior side produced; umbo summit prominent; posterior extremity acutely rounded; beaks distant from anterior margin; anterior side of the umbo subangulated. (Plate II, fig. 2.)

*Panopæa elongata*, Con.; Trans. Geolog. Soc. of Penn., Vol. i, p. 339, Plate XIII, fig. 1.

Piscataway, Md.

Allied to Panopæa intermedia of Sowerby, but proportionally much longer, with more of a cuneiform posterior side, &c. It accompanies Pholas petrosa and Pholadomya Marylandica, consisting of indurated casts, coated with a portion of the shell. It is very abundant, having the valves connected, like the associated bivalves, proving that the species lived on the spot where it is now found. The stratum in which it is imbedded is the summit of the Eocene, and is of inconsiderable thickness. It bears no evidence of having been deposited in agitated waters.

### LUTRARIA.

The genus Lutraria of Lamarck, was unknown to Deshayes in the European Eocene formation in 1833, but he noticed a few species in the Miocene strata. Sowerby has referred some shells of the Inferior Oolite, green sand and chalk to this genus, but perhaps the hinge was not observed, and the generic character may be therefore doubtful. In this country, I find two species in the Eocene, and Say has described two recent species from the southern coast. In the Miocene strata, I have not met with the genus. The Post-pliocene of North Carolina, contains the recent L. canaliculata, Say.

LUTRARIA LAPIDOSA. Obliquely ovate, convex, with rather distinct large concentric sulci, obsolete towards the base; summits very elevated, from which the anterior and posterior dorsal margins decline very obliquely; anterior extremity angulated; posterior side cuneiform towards the end margin, which is acutely rounded or subangulated; anterior basal margin very oblique, subtruncated. (Plate I, fig. 7.)

Orangeburg, S. C.

I have but one specimen, a cast in indurated clay, without a trace of the original shell remaining upon it.

LUTRARIA PAPYRIA. Ovate, very thin and fragile, inflated anteriorly; surface with concentric sulci, profound on the sides and obsolete in the middle, and with numerous interrupted wrinkled lines from umbo to base; anterior end abruptly rounded; posterior side cuneiform, compressed, gaping; a slight fold, and nearer the end margin, an undulated line from beak to base; submargin angular, with a narrow depressed area at the extremity of the valves. (Plate I, fig. 8.)

*Lutraria papyria*, Con.; Foss. Shells of Tert. Form., p. 41.

Claiborne, Alabama.

A very rare species and extremely fragile. I have only one valve nearly perfect and the fragment of another. The teeth and cardinal grooves are remarkably large and profound.

## MACTRA.

The genus Mactra appears to be peculiar to the tertiary formations in a fossil state. I have seen no unquestionable species in secondary rocks. Deshayes enumerates fifteen fossil species of Europe, two of which are in the Paris Eocene. I find three species in the Alabama Eocene, all of which are small. The Miocene strata of Maryland and Virginia contain the largest known species, excepting the recent M. solidissima. This formation has furnished ten species. Four recent Mactræ inhabit the eastern and middle coasts of the Union. One of these, M. lateralis, is common in the Gulf of Mexico on many of the Keys, and occurs fossil in Virginia and North Carolina both in Miocene and Post-pliocene deposits.

This genus has been subdivided by Gray into the genera Spisula, Scissodesma and Mulinia. I have no doubt the anatomical structure of the animals of these three groups will, when better known, authorize the genera of this distinguished naturalist.

MACTRA DECISA. Triangular, ventricose, umbonial slope angular, slightly carinated; posterior slope much depressed, with a line somewhat bifid or double from beak to base, and short oblique prominent lines on the upper portion of the valves; cardinal fosset large and profound, the anterior tooth adjoining it triangular, with a deep pit on each of the three sides. (Plate II, fig. 3.)

*Mactra decisa*, Con.; Foss. Shells of Tert. Form., p. 42, Oct. 1833.

*M. dentata*, Lea; Cont. to Geol., p. 41, Plate I, fig. 9. Dec. 1833.

Claiborne, Alabama.

This very rare species has not been found entire. I have only one fragment, and the hinge of this is perfect enough to exhibit the fissure in the hinge line under the apex, which characterizes the genus Scissodesma.

MACTRA PARILIS. Triangular, equilateral, smooth and polished; both ends depressed and striated; umbonial slope slightly folded; anterior angle with an impressed line; cavity capacious. (Plate II, fig. 6.)

*Mactra parilis*, Con.; Foss. Shells of Tert. Form., p. 42, Oct. 1833.

*M. pygmæa ?* Lea; Cont. to Geol., p. 44, Plate I, fig. 11, Dec. 1833.

Claiborne, Alabama.

This species has some resemblance in outline to the M. lateralis of Say, but its specific character is very different. It probably belongs to the genus Mulinia.

MACTRA PRÆTENUIS. Subtriangular, compressed, equilateral, thin and fragile; umbonial slope submarginal, subrectilinear, carinated; beaks slightly prominent; posterior slope with two prominent fine lines and obliquely rugose; surface of the valves with very minute concentric closely arranged lines. (Plate II, fig. 4.)

*Mactra prætenuis*, Con.; Foss. Shells of Tert. Form., p. 42.

Claiborne, Alabama.

This shell is very rare. It has somewhat the outline of M. delumbis, of the Miocene, but is a much smaller and very distinct species. It has the cardinal fissure which would constitute it a member of the genus Scissodesma.

### TRIQUETRA, *Con.*

This genus differs from Mactra and Mesodesma in having a less profound and much smaller cardinal fosset, which does not extend more than half the width of the cardinal plate, which is broad and thick. The substance of the shell is thicker than in Mactra, and the anterior muscular impression more profound. Exteriorly this genus is distinguished by a triangular outline,

flattened umbo and acute apex which is scarcely oblique. It does not agree with either Scissodesma or Mulinia.

In a fossil state we find only the two following species. I have seen none recent.

TRIQUETRA ÆQUOREA. Triangular, equilateral, thick, plano-convex; umbonial slope submarginal, angulated; umbo flattened, apex acute; anterior extremity acutely rounded; posterior extremity obliquely truncated; cardinal plate very thick; fosset small, ovate; cardinal plate thickest under the anterior cardinal tooth. (Plate II, fig. 5.)

*Erycina æquorea*, Con.; Foss. Shells of Tert. Form. p. 42, Oct. 1833.

*Mactra Grayi*, Lea; Cont. to Geol., Plate I, fig. 10.

Claiborne, Alabama.

A common species, the valves of which are always found separated. The substance of the shell is remarkably thick.

TRIQUETRA RECTILINEARIS. Triangular, flattened above, with coarse lines of growth; posterior side subcuneiform, rather longer than the anterior side, extremity subtruncated; umbo much flattened, apex acute; posterior dorsal margin rectilinear; basal margin a little tumid near the middle. (Plate II, fig. 8.)

*Erycina rectilinearis*, Con.; Foss. Shells of Tert. Form. p. 42.

Claiborne, Alabama.

This shell is larger, thinner, more inequilateral than the preceding, and very rare. The cardinal plate is less thickened and the anterior muscular impression not so deeply impressed. Both species have an indistinct impressed line on the exterior, extending from the anterior end to the apex.

## *Explanation of Plates.*

PLATE I.

Fig. 1. Siliquaria vitis.
2. Dentalium thalloides.
3. D. arciformis.
4. Anguinella ornata.
5. Fistulana larva.
6. Balanus peregrinus.
7. Lutraria lapidosa.
8. L. papyria.
9. Pholadomya marylandica.

PLATE II.

Fig. 1. Pholas petrosa.
2. Panopæa elongata.
3. Mactra decisa.
4. M. prætenuis.
5. Triquetra æquorea.
6. Mactra parilis.
7. Crassatella protexta.
8. Triquetra rectilinearis.

*List of organic remains in the American Eocene which are analogous to European species.*

1. *Crassatella alæformis*, Con. Very much like C. rostrata, Desh. in outline, but differs in having sulci over the whole disk.
2. *C. alta*, Con. Approaches very near to C. tumida. (Paris.)
3. *Fistulana larva*, Con. Allied to F. elongata, Desh. (Paris.)
4. *Corbula oniscus*, Con. Closely allied to F. angustata, Sow., and resembles C. ombonella, Desh.
5. *Panopæa elongata*, Con. Allied to P. intermedea, Sow. (Bognor Rocks, England.)
6. *Lucina lapidosa*, Con. Allied to L. contorta, Desh., but is much more elevated.
7. *Lucina symmetrica*, Con. Allied to L. scalaris, Lam. (Paris.)
8. *Cytherea Mortoni*, Con. Analogous to C. erycinoides, Lam., and to C. suberycinoides, Desh. (Paris.)
9. *C. semipunctata*, Con., has a general resemblance to C. lævigata, Lam.
10. *Cardita Blandingi*, Con. Analogous to C. acutiscosta, Lam. (Paris.)
11. *C. rotunda*, Lea. Analogous to Venericardia asperula, Desh. (Paris.)
12. *Cardium Nicolleti*, Con. Closely analogous to C. semigranosum, Sow., (Paris,) and resembles C. semistriatum, Desh., but differs in having radiating lines over the whole disk.
13. *Cucullæa gigantea*, Con. Very like C. crassatina, Lam. (Paris.)
14. *Byssoarca cuculloides*, Con. Somewhat resembles Arca rudis, Desh. (Paris.)
15. *Pectunculus idoneus*, Con. Closely appproaches a Paris species in my cabinet which I do not recognize among Deshayes' figures of the Paris fossils.
16. *Avicula limula*, Con. Analogous to A. trigona, Lam. (Paris.)
17. *Ostrea georgiana*, Con. Allied to O. longirostris, Lam.
18. *Turritella Mortoni*, Con. Analogous to a species in the London clay.
19. *T. humerosa*, Con. Closely allied to T. imbricataria, Lam. (Paris.)

20. *Fusus perlatus*, Con. Resembles F. ficulneus. (Paris.)
21. *F. pachyleurus*, Con. Allied to F. conjunctus, Desh. (Paris.)
22. *Rostellaria laqueata*, Con. Very analogous to R. fissurella, Lam. (Paris.)
23. *Voluta Sayana*, Con. Allied to V. luctator, Sow. (London clay.)
24. *V. petrosa*, Con. Closely allied to V. spinosa. (Paris.)
25. *Oliva alabamensis*, Con. Allied to O. plicaria, Lam.
26. *O. bombylus*, Con. Allied to O. clavulus, Lam.
27. *Ancillaria staminea*, Con. Allied to A. canalifera, Lam. (Paris.)
28. *Monoceros vetusta*, Con. Very nearly allied to Murex minax, Brander, (Fusus minax, Lam.) (London clay and Paris.)

NOTE.—I add here a few remarks upon some tertiary fossils recently described by Mr. Lonsdale and Mr. Forbes, in the Proceedings of the Geological Society of London, iv, part 3.

*Anthophyllum lineatum*, Lonsdale. This Miocene coral I figured and described in the Transactions of the Geological Society of Pennsylvania, i, 340, pl. 13, fig. 4, 1835, where it bears the name of *Lithodendrum lineatum.*

*Astræa hirtolamellata*, Michelin. The species thus designated by Lonsdale is named by me *Astræa marylandica*, in the Proceedings of the Academy of Natural Sciences of Philadelphia, for June, 1841, p. 33.

*Amphidetus virginianus*, Forbes. This echinoderm is described by me in the Proceedings of the Academy of Natural Sciences, for Dec., 1843, vol. i, p. 327; and is there named *Spatangus orthonotus.* If the generic name be changed, the species should stand as the *Amphidetus orthonotus.*

*Echinus Ruffinii*, Forbes. This species appears to be identical with my *E. philanthropus*, in the Proceedings of the Academy of Natural Sciences of Philadelphia, for Oct. 1843, vol. i, p. 310.

*Endopachys alatum*, Lonsdale. This is the *Turbinolia Maclurii* of Lea, and is figured in the *Contributions to Geology*, Plate VI, fig. 206. Lonsdale's figures *b*, *c*, of another species of Endopachys, represent apparently the *Turbinolia Stokesii* of Lea; *Contributions to Geology*, Plate VI, fig. 207.

*Additional Remarks*, by J. D. DANA.—The genus *Endopachys* of Lonsdale includes certain Turbinoliæ, either turbinate or cuneiform,

with the base and sides rather thick and porous, and resembling much in texture and the lamellæ of the cells the Dendrophylliæ. The thickening of the corallum is described as taking place from within through foramina, and upon this character the genus is founded, and to it the name alludes—from *ενδον within*, and *παχυς thick*. On an examination of specimens of the same species figured by Lonsdale, I see no evidence of this anomalous mode of secretion; they appear very similar in character to some Dendrophylliæ, except that they are free and simple, and are different in shape, and exterior markings. After an examination of numerous coral zoophytes in the living state, I am led to doubt the propriety of the grounds upon which the genus is based. But one principle as regards the secretion of coral, runs through all the species of the Caryophyllia and Astræa tribes, as far as examined by the writer, and in all instances they appear to be internal secretions, very analogous in mode of formation to the calcareous secretions of other animals.

The *Madrepora tubulata* of Lonsdale, in the same memoir, is an *Oculina*.

The *Columnaria sexradiata*, is allied to the Astræa calicularis of the Mediterranean, for which I have adopted as a generic name, *Astroitis*, from Boccone. The recent species is characterized by long prominent polyps when expanded, and has not the terminal mode of budding which distinguishes the genera of the Astræa tribe. The subdivision of polyps which takes place in most Astræas is the result of disk-budding; but in these species the polyps are only united to one another at base, and the buds are therefore basal or lateral, instead of terminal, and make their appearance in the interstices. The exposed polyps are prominent, because they secrete lime only in their lower or basal portions.

The species referred to the *Astræa hirto-lamellata* of Michelin by Lonsdale, is closely allied to the preceding, and either belongs to the same genus, or to the group *Pleiadia* of the writer, which is distinguished from *Astroitis* by having the cells of the corallum solidly coalescent. An allied species before me has the interstitial mode of budding of the Astroites, and judging from analogy, the polyps were probably prominent, as in that genus.

ART. VIII.—*An account of the Geology of Harpeth Ridge, Davidson Co., Tenn.;* by I. N. LOOMIS, Franklin College, Tenn.

DURING a geological exploration of a few days, by a number of the students and faculty of Franklin College, Tennessee, a few observations and discoveries were made, an account of which may be of interest to the readers of your Journal.

The college is four miles east from Nashville, and our course from this point was in a southwesterly direction, on the old Franklin road to the Harpeth ridge, bordering the Harpeth river, a branch of the Cumberland, entering it about twenty miles below Nashville.

The formations of this region, belong to the Lower Silurian, and we were able to identify most of them with the corresponding ones of New York and Ohio. The first of these was that corresponding with the blue shaly limestone of Ohio and Kentucky, and exposed for several miles around Cincinnati, which, according to Mr. James Hall, is identical with "the rocks of the Mohawk and Hudson valleys in New York."*

In Middle Tennessee, the rocks dip to the south, and we came on to this one at the base of the ridge, which at this place is from fifty to sixty feet in thickness. The evidences of identity between these two formations are full and satisfactory. Two or three species of Delthyris; a well defined Trochus; a beautiful encrinite; Orthis testudinaria, O. callactus, and several other species; a very small Atrypa, abundant at Cincinnati, and named by the Western Academy of Sciences, Atrypa communis; numerous corallines, among which are the Favosites muricata, F. milliporacea, and a beautiful star coral; Strophomena sericea, S. alternata, and one or two others; and a species of Bellerophon, were all found here, which, on comparison with those procured at Cincinnati, could not be distinguished from them, by a close examination.

Were farther proof of their identity wanting, it might be found in the microscopic shells in the marly clay accompanying them, discovered by Mr. J. Carley at Cincinnati, and described by Mr. James Hall in a previous number of this Journal.† These were found in large quantities, beautiful and perfect,

* This Journal, Vol. XLVIII, p. 293. † Vol. XLVIII, No. 2d.

besides several species not described, and some microscopic corallines. As regards their lithological characters, there was observed sufficient resemblance in their color and texture, to lead to the conjecture of their correspondence, before examining the fossils.

Immediately above this, occurs a yellowish brown calcareous rock, about ten feet in thickness, containing numerous small cavities, filled with quartz crystals.

In this were found no fossils, except in the upper stratum, where were obtained a small Orthis in great abundance, several species of coral, a Delthyris and Cyathophyllum. Next in order is a red limestone, which on disintegration furnishes a material, resembling Spanish brown. The red color of many of the microscopic shells mentioned above, suggested an examination in this rock. In it were discovered the Cyclora and Nucula. Thickness from six to eight feet.

The next formation identified was a peculiar one, corresponding with a portion of the Niagara group of New York, developed at Lockport, and usually termed the red encrinal limestone. It is composed chiefly of fragments of encrinital columns, many of which are colored red. Being perfectly familiar with that at Lockport, I have little hesitation in pronouncing this the same, for they possess peculiarities of color and structure not easily mistaken—the latter being furnished by the fracture of the plates composing the encrinal columns. Allowing that some of the formations of New York are wanting here, its stratigraphical position is also favorable to this conclusion. It is about twenty feet in thickness. Above this, is found a light snuff-colored rock, which also contains the microscopic shells; and on examination with a powerful magnifier, it seems almost entirely composed of them. From this they are doubtless chiefly furnished, as its color corresponds with the marl and disintegrated rock in which they are found, as also the color of the shells, except some that are red. This, on the north side of the ridge, is but three or four inches thick, but on the opposite side, about one mile south, it is about fifteen inches in thickness.

Next occurs a stratum of shale from twelve to fifteen feet in thickness. Although upon minute examination, no traces of organic remains were found in it, yet there is little doubt of its identity with the Marcellus shales, or "pyritiferous" of Eaton in New York, as will be seen when its position is more fully described. At a place several miles below this, on the east bank

of the Harpeth, we examined a well exposed section of about one hundred feet. In it, and between the red encrinal limestone and the shale, occurs a formation of limestone, of a dark color, filled with masses of chert, and in appearance resembling the "corniferous" of New York. Although we had but a short time to examine it, I doubt not it is the same. By a reference to the reports of Dr. Troost, geologist of Tennessee, it will be seen that the strata of this region often run out, and others occur within the space of a few miles. No traces of the last mentioned rock were found at the former place of examination, yet the whole region is strown with fragments of chert, which have doubtless been furnished from it.

Another evidence of the identity of the shales is a stratum of limestone found in them. At the mouth of Eighteen Mile Creek, on the south shore of Lake Erie, eighteen miles from Buffalo, a stratum of limestone, three or four feet in thickness, may be seen projecting from the shale near the top of the bank, and having fallen in numerous masses on the beach.

It contains large irregular masses of iron pyrites. The shale at Harpeth contains a similar stratum of less thickness, but resembling it in structure and external appearances, except being somewhat darker, and contains similar masses of sulphuret of iron. The shale also contains pyrites in minute particles, and a considerable quantity of bitumen—both characteristics of the Marcellus shale, the latter circumstance having led to numerous excavations in them both, in search of fossil coal.

But the character of the shale, as well as that of the rock containing the chert, is satisfactorily determined by the two which succeed it, and cap the hills in this vicinity. These are the Gardeau or Lower Fucoidal, and the Portage or Upper Fucoidal groups of New York. Mr. Hall in his report for 1840 remarks, that no formations in the state are better characterized than these, and that almost the only fossils they contain, are the Fucoides graphica in the former, and F. verticalis in the latter. In both of the strata next above the shale, these fossils were respectively found, and so nearly resembling those of the Gardeau and Portage groups in appearance and position, as not to be mistaken. In these were also found those nodular concretions often met with in the other. Besides the composition, the peculiar olive color and all the external characters of these rocks are easily recognized.

ART. IX.—*Notice of some Genera of Cyclopacea;* by J. D. DANA.

As a preface to the descriptions which follow, a classification of Crustacea is here given; it is made out so as to exhibit to some extent the parallel relations of the several orders and subdivisions.

CRUSTACEA.

| Subclassis I. PODOPHTHALMIA. | Subclassis II. EDRIOPHTHALMIA. | | | Subclassis III. MANDYATA.‖ |
|---|---|---|---|---|
| Ordo 1. DECAPODA. | Ordo 1. CHORISTOPODA.* | | | |
| Tribus<br>1. Brachyura.<br>2. Anomoura.<br>3. Macroura. | Tribus<br>1. Isopoda.<br>2. Læmipoda.<br>3. Amphipoda. | | | |
| Ordo 2. SCHIZOPODA. | Ordo 2. ENTOMOSTRACA. | | | |
| | Subord. 1. GNATHOSTOMATA.† | Subord. 2. CORMOSTOMATA.‡ | Subord. 3. MEROSTOMATA.§ | |
| Tribus<br>1. Stomapoda.<br>2. Diploöpoda. | Tribus<br>1. Branchipodacea.<br>2. Limnadiacea.<br>3. Daphniacea.<br>4. Cyclopacea.<br>5. Cypridacea. | Tribus<br>1. Caligacea.<br>2. Lernæacea.<br>3. Nymphonacea. | Tribus<br>1. Limulacea. | Tribus<br>1. Cirripeda, or Balanacea.¶ |
| | Ordo 3. TRILOBITA. | | | |

## Order ENTOMOSTRACA.

### Tribe CYCLOPACEA.

To avoid explanations in the following descriptions, we here enumerate the prominent external characters of this tribe.

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* From χωριστος *separate*, and ποους *foot*, alluding to the fact that the pairs of feet belong each to a distinct segment of the body.

† From γναθος *jaw*, and στομα *mouth*, alluding to the mouth being furnished with proper mandibles and maxillæ.

‡ From κορμος *trunk*, and στομα *mouth*, the mouth having the form of a movable trunk.

§ From μηρος *thigh*, and στομα *mouth*, the basal joints of the legs constituting the jaws.

‖ From μανδυη *a cloak*, alluding to the covering in which the body of the animal is enclosed.

¶ The Cypris-like young of several Anatifæ were collected and figured by the writer, and the metamorphosis traced to the adult state. When first found swimming free in the ocean, they were taken for a new genus allied to Cypris, so similar are their forms. The fact that the body and legs of the Cirripeda shed their skin, is further evidence of the propriety of placing this group with Crustacea.

The pedicel of the Anatifæ corresponds to a pair of antennæ in the young; the animal attaches itself by the sucker-like disk terminating these organs before the metamorphosis commences, and in a group of Anatifæ all the different stages may be observed, from the pair of distinct antennæ to the fixed simple pedicel.

*Body* jointed, the carapax not prolonged beyond the joint to which it belongs; *abdomen* not inflexed.

*Eyes* simple.

*Antennæ* two pairs; the second often pediform or subcheliform.

*Mandibles* 4–5-spino-dentate, sometimes having a subnatatory palpus.

*Maxillæ*, one pair; sometimes with a subnatatory palpus.

*Maxillipeds*, one pair; sometimes simple maxillæ; at others, prehensile, but never at all natatory.

*Feet*, 6 pairs; the *first* often prehensile, and subcheliform, and either straight or geniculated; *next four* pairs, bifid and natatory; the *sixth* or *posterior*, (corresponding to another pair of natatories,) rudimentary or obsolete, but in some genera, large in the male, with the right one subcheliform.

*Abdomen*, 2 to 6-jointed; two caudal appendages furnished with 5 setæ, some of which may be obsolete; occasionally short appendages to one or both of the first and second joints.

*External ovaries*, one or two, proceeding from the *second* joint of the abdomen, or what corresponds thereto.

The genera of this tribe here described may be distributed as follows:

1. *Palpi of the mandibles and maxillæ obsolete or wanting, eyes with simple spherical lenses.*

Family 1. Cyclopidæ. External ovaries two. Eyes two, on a single spot of pigment. Abdomen abruptly narrower than the cephalo-thorax.

Genus 1. Cyclops, *Müller*. The two anterior antennæ subcheliform in the male. (Fresh-water species.)

Family 2. Arpactidæ. External ovary single. Eyes two on a single spot of pigment. A short appendage near middle of anterior antennæ. Abdomen seldom abruptly narrower than the cephalo-thorax. (Marine species.)

Genus 1. Arpactus,* *Milne Edwards*. Anterior antennæ short, and both, in the male, subcheliform; posterior pair terminating in a number of movable setæ. Prehensile feet subcheliform.

* Milne Edwards has instituted the genus Cyclopsina for a group near Arpactus having the posterior maxillipeds not subcheliform. In the species examined by the writer the subcheliform character is constant, but the movable finger is sometimes reduced to a very short hook.

Genus 2. SETELLA, *Dana.* Anterior antennæ moderately long, slender, and not subcheliform in the male; posterior pair and prehensile feet nearly as in *Arpactus;* short appendages to the first two joints of abdomen; body slender, and two caudal setæ much longer than the body. (Two movable appendages under the beak.)

The name Setella alludes to the *seta*-like form of the animal, and is from *seta*, a bristle.

2. *Palpi of the mandibles and of the maxillæ prominent, and subnatatory.*

Family 3. CALANIDÆ. External ovary single. Eyes two, the spherical lenses on the same or separate spots of pigment. Anterior antennæ very long and slender, without an appendage. Abdomen abruptly narrower than the cephalo-thorax. (Marine species.)

*a. Posterior thoracic legs rudimentary or obsolete, without appendages. Anterior antennæ alike in the two sexes, and never with a geniculating joint.*

Genus 1. CALANUS, *Leach.* Cephalo-thorax 4-jointed. Anterior antennæ multiarticulate, with the front margin neatly setiferous, and also the posterior apices of the three terminal joints; first pair of feet much larger than the maxillipeds, having outward lateral motion, but scarcely prehensile; maxillipeds very short and straight, setigerous; abdomen short, 2 to 4-jointed. Beak furcate.

Genus 2. SCRIBELLA, *Dana.* Cephalo-thorax 4-jointed. Anterior antennæ, long 7-jointed; setæ long and pointing in different directions. Maxillipeds much larger than the first pair of legs, flexed forward, the three terminal joints as long as the basal, and setigerous, the setæ setulose. Abdomen very long, (as long as the cephalo-thorax;) two setæ to the short basal joint; (a plume or capillary appendage to base of the 8 natatory legs, extending outward at right angles with the body.)

Genus 3. ACARTIA, *Dana.* Anterior antennæ few-jointed; setæ long and pointed in different directions; maxillipeds much larger than the first pair of legs, not flexed, having the terminal joints very short, and setigerous nearly as in the genus *Pontella;* the first pair of legs small and short, not prehensile; the posterior thoracic legs, a single small joint bearing two divergent setæ, one quite long, and usually standing out from the body.

The name Acartia is from *ακαρτος unshorn*, alluding to the long divaricate hairs of the antennæ.

*b. Posterior thoracic legs very long and nearly equal; antennæ of the two sexes alike, without a geniculating joint.*

Genus 4. Euchirus, *Dana.* Anterior antennæ many-jointed, with several long setæ at intervals; first pair of feet much larger than the maxillipeds, very long and doubly geniculate, the apex flexed downward and furnished below with a pencil of naked setæ; motion of these organs forward in the line of the body, and not outward. Posterior thoracic legs in male very long, and the right one subcheliform. Beak pointed, in lateral view emarginate.

*c. Posterior thoracic legs in the male large, the two unequal, and the right subcheliform; the right one of the anterior antennæ in the same sex having a geniculating joint about one third its length from the apex.*

Genus 5. Pontella.* Anterior antennæ multiarticulate, the setæ as in *Calanus.* Maxillipeds much larger than the first pair of legs, not flexed, and having the terminal joints short and setigerous, the setæ extending forward to the mouth and setulose, as in *Acartia;* the first pair of legs small and short, not prehensile. The right posterior thoracic leg in the male large cheliform, the left smaller and often simple. Beak furcate. Caudal setæ more or less spread. (There is a large glassy appendage under the head, with a rounded or reniform summit.)

Genus 6. Candacia, *Dana.* Anterior antennæ and posterior thoracic legs, nearly as in *Pontella;* the first pair of legs much larger than the maxillipeds, elongate, and flexed forward, with the extremity inflexed and bearing a pencil of long naked setæ, motion in the line of the body. Front truncate; caudal setæ usually not spread. Color often in part black or nearly so.

3. *Palpi of the mandibles and maxillæ obsolete; two simple eyes?; also two oblate lenses in the front, and two prolate lenses posterior to these within, which may constitute another pair of eyes.*

Family 4. Corycæidæ. Tentacles short, few-jointed; external ovaries two.

Genus 1. Corycæus,† *Dana.* Body not depressed. Abdomen abruptly narrower than the body, 2 or 3-jointed; second pair of antennæ

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* The name Pontia, applied to this group by Milne Edwards, was previously applied to a genus of insects, and has therefore been changed as above. The genus *Cetochilus* of Roussel de Vauzème does not differ essentially from Pontella.

† See Proceed. of Acad. Nat. Sci. of Philad. for October, 1845, p. 285. The two lenses in these animals are separated by an unobstructed space, and appear beyond doubt to serve for the transmission of light. In contact with the posterior lens behind is an oblong spot of dark pigment. The only other supposition with

subcheliform, larger than the first pair of legs, (nearly as in the genus Ergasilus.)

Genus 2. ANTARIA, *Dana.* Similar to *Corycæus*, but having the second pair of antennæ terminating in a few movable setæ, and smaller than the first pair of legs. (I am not satisfied that these specimens are not the female of the Corycæi.)

Genus 3. SAPPHIRINA, *Thompson.* Body much depressed; antennæ as in *Corycæus;* abdomen 5 or 6-jointed, the basal joint in the female abruptly narrower than the thorax, and having a pair of short appendages; external ovaries two.

Family 5. MIRACIDÆ. Antennæ as in *Setella;* external ovary single.

Genus 1. MIRACIA, *Dana.* Body not depressed, nearly as in the *Arpactidæ*, the abdomen 5 or 6-jointed and not abruptly narrower than the thorax; anterior antennæ nearly as in *Setella*, with a short appendage near the middle; second pair of antennæ terminating in a few movable setæ; beak with two cultriform appendages; first pair of legs subcheliform.

The distinctions in the above genera rest to a considerable extent upon the use of different organs for grasping in the union of the sexes. In *Cyclops* and *Arpactus*, both anterior antennæ of the male are subcheliform for this purpose; in *Pontella* and *Candacia*, the right antenna and right posterior thoracic leg is thus modified in the male; in *Euchirus*, both posterior thoracic legs are very much elongated; in *Calanus*, the first pair of legs are long and have an outward lateral motion for the purpose; in *Corycæus* the second pair of antennæ subserves this end, and in *Antaria* the first pair of legs are large and subcheliform; in *Setella* the same end appears to be secured by the first pair of natatories.

The genera of Calanidæ differ also in the relative development of the maxillipeds and first pair of legs. In *Pontella*, *Acartia*, and *Scribella*, the maxillipeds are largest. In *Pontella* and *Acartia* they are straight, with long setulose setæ directed forward so as to form a kind of scoop-net. In *Scribella* they are flexed like the letter L. In *Calanus*, *Euchirus* and *Candacia*, the first pair of legs are larger than the maxillipeds; in *Calanus* they are long

regard to their nature which I can suggest, is their possible connection with phosphorescence. But such an arrangement for this end is not probable; and moreover I was never satisfied that the species were phosphorescent.

and spread outward laterally; in *Euchirus* they are thrown forward in the line of the body, and are flexed like the letter ⊬; and in *Candacia* they have nearly a similar position, but have the extremity flexed *towards* the head instead of *away* from it.

The maxillipeds may always be distinguished from the first pair of legs by the setæ, which are *setulose* in the former, and *naked* in the latter.

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ART. X.—*On the Law of Electric Conduction in Metals;* by JONATHAN H. LANE.

MY attention was first directed to the subject of the law of conduction by reading a paper by Prof. Morse, published in this Journal, Vol. XLV, p. 390, first series, accompanied by a communication from Prof. Draper. These communications gave me the impression that the law commonly received was not well ascertained, and it was under this impression that the experiments given in the following paper were made. But since it was written, I have found that I had mistaken the particular aim of Prof. Morse's experiments, which did not profess superior accuracy, but were only intended as experiments on a large scale by way of verification. Experiments have long since been made by different electricians, which afford strong support to the law in question, while others were thought to controvert it; but they have either been explained, or are not in their nature satisfactory. Still, my own method of experiment appears to possess advantages over any that I have seen; and notwithstanding the imperfect manner in which it has been carried out, it has given results more exactly corresponding with the supposed law. I must say, however, that my experiments have by no means been sufficiently extended, for those given are all I have made touching this question.

1. Supposing electricity to be a fluid, and an electric current to be no more than the motion of this fluid through a conductor, which, at the same time, opposes a resistance to its motion, it is a natural inference, that as electric motion is known to result from difference of tension, so conversely, there is always a difference of tension in the different parts of a conductor, while conducting a current—a regular gradation in the quantity of elec-

tric fluid, from one end to the other, as in the height of flowing water in a canal, and more or less rapid or abrupt, according to the conducting power of the different parts of the conductor.

Hence we should expect that if any two points of such a conductor, however near together, were connected by a second conductor, of whatever length, a current would at once flow through the latter. Accordingly, the poles of an ordinary galvanic battery being connected by a good metallic conductor of two or three feet length, the current generated in a second conductor was made instantly apparent; when it included between its extremities not more than a half inch of the battery conductor, and the effect, as might be expected, increased in proportion to the interval between the extremities of the second conductor. This satisfied me that by such experiments as I had proposed, the law of conduction could be ascertained with much certainty.*

2. The law of Lenz embraces two propositions.

(1.) In a given conductor, the quantity of fluid conducted in a given period, is as the intensity, or difference of tension between the ends of the conductor.

(2.) In homogeneous conductors of the same length, and with the same difference of tension, the quantity conducted is as the section.

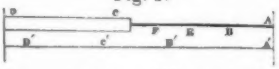
3. To test the truth of the first of these propositions, we divide the current of one or more wires, among two or more others of the same size, and then compare a given length of the former wire or wires, with such length of the latter as shall have the same difference of tension. If, for example, part of a galvanic circuit be composed of a single wire, and another part of two wires of the same kind, and if the difference of tension in a foot of the single wire be found equal to the difference of tension in two feet of either of the pair, the inference is that each of the latter, which conducts half the quantity of the former, requires half the intensity.

4. To find lengths which have equal differences of tension, two methods may be taken. The one will require a galvanometer having a double coil of two very fine wires of great length, so as to conduct a very small quantity, and still act with conside-

* Becquerel, it appears, entertained the same view of the electric state of a conducting wire, and illustrated it by an experiment of precisely the same kind.

rable power on the needle. Let AD (fig. 1) be a conductor made up of a single wire AC,* and several CD. The battery circuit being completed, let the points C and D be connected by one of the wires of the galvanometer. The needle will be powerfully deflected. Now let E and F be connected by the other wire of the galvanometer, but so that the current arising may act in opposition to the former, and let the space EF be increased till the actions on the needle balance each other. Next, let the points A and B be connected by the same wire as C and D before, and AB increased till the needle is stationary. Then AB and CD will have equal differences of tension, for though the galvanometer wire did draw out a small fractional part of the battery current, still it was the same quantity in both cases. EF might be taken instead of AB, if we could be sure the wires of the galvanometer were exactly equal in their actions, and this adjustment might be made without much difficulty.

Fig. 1.



5. A better method, and the one I adopted, is the following. It requires only a galvanometer of the ordinary construction. Let A′D′ be a uniform conducting wire placed alongside of AD, and well connected with it at the extremities. If, while a current is passing, any point of AD be connected through the galvanometer with a point of A′D′, of different tension, the needle will be deflected, but a point may always be found in A′D′, where no deflection will take place. Let A and A′ be points of equal tension ascertained in this manner, as also B and B′, C and C′, and D and D′, and let $m$ represent the number of the wires AC, and $n$ the number of CD. Then, if A′B′ be made equal to C′D′, AB and CD will have equal differences of tension, and according to the first proposition we shall have

$$n \,.\, \mathrm{AB} = m \,.\, \mathrm{CD}.$$

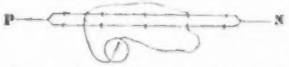
Or if A′B′ and C′D′ be not equal, we may reduce to equal lengths by substituting for the ratio of AB to CD, that of AB . C′D′ to CD . A′B′, and we shall have

$$n \,.\, \mathrm{AB} \,.\, \mathrm{C'D'} = m \,.\, \mathrm{CD} \,.\, \mathrm{A'B'}.$$

* If this method be taken, AC must either be a single wire, or, if several, they must be well joined near as may be to B, A being at the same time taken near the connected extremities; and the same caution must be applied to the common measure EF, unless it be taken on a single wire, introduced for the purpose, so as to convey the whole current. C and D also must be near the connected extremities of the wires.

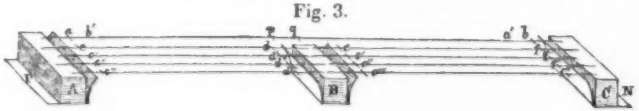
6. A galvanometer for these experiments was formed of two sewing needles, and about twenty turns of No. 31, brass wire, covered with silk. A preliminary experiment was made, to settle the question whether any great inequality of conducting power existed in a metallic wire, it being obvious that such inequality might exist, without being ordinarily apparent. Iron wire of about one twentieth of an inch in diameter was first tried. Two parallel wires were connected at the ends, and made to form part of a galvanic circuit, (fig. 2.) One of these was then divided into several equal parts, and for each of the points of division, a point of equal electric tension was found in the other, by extending a conductor from the point in the first wire through the galvanometer to the second, and passing along the latter till the needle ceased to be deflected. The points thus determined in the second wire, were very nearly equidistant. Brass wire was tried in a similar manner, and with the same result. For the convenient performance of these and the subsequent experiments, two slides were used to move on the conducting wires, carrying in contact with them bits of brass wire crossing at right angles. These latter wires were connected with the galvanometer by metallic ribands, one of which was divided in the middle, so that the connection could be made and broken at pleasure. This was done with wooden handles, to prevent the disturbance which was found to arise from thermo-electricity, if the hand touched the conducting ribands.

Fig. 2.




7. For the course of experiment already indicated, No. 22 brass wire was used. To a piece of board were attached bridges A, B, C, (fig. 3,) and on these were strained several pieces of the wire, as shown in the figure, *ab* being a single wire, which we

Fig. 3.




may call the gauge wire, of near six feet, and matched by four others *cd* of about two feet, and four *ef* of over three feet. These wires were insulated from one another by the dry wood, except when soldered to pieces of sheet copper P, O, N, passing under the bridges. With this arrangement, the experiments could be conveniently varied, by leaving more or less of the wires out of

the circuit. The gauge wire $ab$ was, of course, always soldered at $a$ and $b$, and for the first trial $cd$ and the two $ef$, $e'f'$, were soldered evenly as possible, and the battery current passed from P to N. Not trusting to the exact equality of electric tension between the points $a$ and $c$, $b$, $f$ and $f'$, $e$ and $e'$, at the ends of the copper plates, points of equal tension near them were carefully ascertained by actual experiment, which points we designate still by the same letters. Also points of equal tension $p$ and $d$, and a point $q$, of equal tension with $e$ and $e'$. The result for the length of the several parts was,

(1.) $ap=29{\cdot}93$ inches, $qb=29{\cdot}93$ in. $ef=37{\cdot}98$ in.
$cd=19{\cdot}02$ " $e'f'=37{\cdot}98$ "
Here $2cd : ef$, (§ 5.) : : 634 : 633.

Adding the wire $e''f''$ to the previous ones, and taking all the points of equal tension anew, the result was,

(2.) $ap=23{\cdot}48$ in. $qb=23{\cdot}48$ in. $e'f'=38{\cdot}05$ in.
$cd=12{\cdot}71$ " $e''f''=38{\cdot}06$ "
$3cd : ef$ : : 508 : 507.

Adding next $e'''f'''$, and proceeding in like manner,

(3.) $ap=47{\cdot}43$ in. $qb=19{\cdot}35$ in. $e'f'=38{\cdot}10$ in. } mean,
$cd=23{\cdot}41$ " $e''f''=38{\cdot}13$ " } 38·12.
$e'''f'''=38{\cdot}14$ "
$4cd . qb : 38{\cdot}12 . ap$, (§ 5.) : : 465 : 464.

Comparing in the same way three wires $cd$, $c'd'$, $c''d''$, with the four $ef$,

(4.) $ap=29{\cdot}69$ in. $c'd'=23{\cdot}19$ in. } mean, 23·20.
$c''d''=23{\cdot}21$ " }
$qb=36{\cdot}68$ in. $e'f'=38{\cdot}13$ in. } mean, 38·14.
$e''f''=38{\cdot}15$ " }
$4qb . 23{\cdot}20 : 3ap . 38{\cdot}14$ : : 500 : 499.

8. These results show the approximate truth of our first proposition; but the deviations are observed to be all on one side, and remarkably uniform in magnitude. To ascertain whether this was not owing to a small inequality of conducting power, the experiments were varied by reversing the wire $ab$, marked now $b'a'$. Comparing $cd$ with $ef$ and $e'f'$, and finding points of equal tension as before, the result was,

(5.) $b'p=35{\cdot}95$ in. $qa'=30{\cdot}07$ in. $ef=38{\cdot}06$ in.
$cd=22{\cdot}91$ " $e'f'=38{\cdot}06$ "
$2cd . qa' : ef . b'p$ : : 144 : 143.

9. This is a great increase of deviation on the same side, and might be explained by supposing the single wire *cd*, a better conductor than the wires *ef*, and also the end *a* of the gauge wire, better than the end *b*. This last difference, which must be the smaller, would partly cancel the other in the first experiment, but augment it in this. To ascertain, then, whether superior conducting power in *cd* had a part in causing the deviations, $c'd'$, $c''d''$, and $c'''d'''$, were successively compared with *ef* and $e'f'$, *ab* still retaining the reversed position. The results gave,

With $c'd'$, (6.) $2c'd' \,.\, qa' : ef \,.\, b'p :: 3260 : 3261.$*

" $c''d''$, (7.) $2c''d'' \,.\, qa' : ef \,.\, b'p :: 398 : 397.$

" $c'''d'''$, (8.) $2c'''d''' \,.\, qa' : ef \,.\, b'p :: 7500 : 7501.$

10. Granting that the end *b* of *ab* is inferior in conducting power to the end *a*, it would appear by the result of the 6th and 8th, that to compensate nearly this inequality in those cases, $c'd'$ and $c''d''$ are each inferior to the pair *ef*. If this is so, we ought on restoring the gauge wire to its original position, to have with $c'd'$ and with $c'''d'''$ a large deviation on the side opposite to that of the deviations in the first experiments. Accordingly *ab* was restored to its first position, and comparing $c'''d'''$ with the pair *ef*, the result gave,

(9.) $2c'''d''' \,.\, qb : ef \,.\, ap :: 187 : 188.$

With $c'd'$, (10.) $2c'd' \,.\, qb : ef \,.\, ap :: 149 : 150.$

11. These two last results, though they do not coincide so exactly as the 6th and 8th would require, still break up the uniformity of the first results, and at the same time, while the disagreement between them does not exceed what might easily arise from error in the measurements taken in them and the 6th and 8th, they give a satisfactory account of any deviations greater than this. So far, then, as these experiments go, they establish the strict truth of our first proposition, that in the same conductor the quantity conducted is as the intensity.†

12. The second proposition would be proved, by showing that each of the parts into which any conductor may be longitudinally divided, conducts its own share of the current, independently of

* The measures taken in the experiments of this and the next article, are of the same general magnitude with those of the 5th experiment, and are therefore omitted.

† In all the foregoing experiments, except the preliminary ones, a single pair of Smee's battery was used.

the rest, i. e. that its conducting power is not affected by any action, either of the adjacent metal as such, or of the current existing in it. This was tried rudely in the following manner. Five brass wires, No. 26, $a'b'c'd'$, (fig. 4,) having their extremities, in common with those of the gauge wire $abcd$, soldered to sheets of tin plate, were bound into a bundle from $a'$ to $b'$, and separated to a little distance through the remainder of their length. The current being passed between A and B, and points of equal tension $a$ and $a'$, &c. taken, the result was,

Fig. 4.

$ab = 25{\cdot}455$ in. $cd = 26{\cdot}080$ in.

$a'b' = 25{\cdot}436$ " Mean of the five $c'd'$, $c''d''$, &c. $= 26{\cdot}187$ "

$a'b' \,.\, cd : c'd' \,.\, ab :: 205 : 206.$

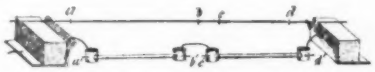
The discrepancy is certainly within the possible limits of unequal conduction in the wires, and the result shows that the wires in the bundle do not mutually interfere with each other's conducting power. This accords with the result of a different experiment of Prof. Faraday, from which he concludes "that collateral currents, either in the same or in opposite directions, exert no permanent inducing power on each other, affecting their quantity or tension."* The inclination of the wires between $b'$ and $c'$, $c''$, &c. is almost exactly compensated by averaging the lengths of $c'd'$, $c''d''$, &c. A more elegant form of experiment would be to compare one part of a wire extended, with the remainder in coil, but we should lose the condition of actual contact between the adjacent wires.

13. The obvious method, however, of deciding the truth of the proposition now under consideration, is to compare two solid conductors of different sections. Wires would not answer, on account of the probable difference of texture in different sizes. Rods of wrought metal of the same size and quality, might be cut and ground down to different sizes without disturbing the texture, taking care to remove the whole exterior portion. Extreme uniformity of section in the conductor would be unnecessary, if the true average be taken by weighing the identical part concerned in the experiment. But having no means to perform

* Experimental Researches, vol. i, p. 6.

such operations, I have only made a single experiment with partially purified mercury in glass tubes. The arrangement is shown in fig. 5. *abcd* the gauge wire used as before, $a'b'$ and $c'd'$ the tubes of mercury, terminated by wooden cups, and the whole connected together as shown in the figure. The cups were pierced with brass pins $a'$, $b'$, $c'$, $d'$, reaching almost to the extremities of the tubes,* and varnished within the cups, except at the points, where the varnish was ground off. On passing a current between P and N, it would be divided between the gauge wire and the tubes of mercury, and the tension at the extremities of the latter could be ascertained by severally connecting the pins $a'$, $b'$, $c'$, $d'$, through the galvanometer, with the corresponding points of equal tension $a$, $b$, $c$, $d$, on the former. With a single pair of Smee's battery, in imperfect order and weakly charged, the result was,

Fig. 5.



$ab = 45{\cdot}619$ in. $cd = 15{\cdot}825$ in.

Tube $a'b' = 20{\cdot}050$ " Tube $c'd' = 15{\cdot}097$ "

Weight of mercury in tube $a'b' = 14{\cdot}095$ grammes.

" " " $c'd' = 23{\cdot}004$ "

Let $ab = \mathrm{L}$, $a'b' = l$, weight of $a'b' = w$, and section of $a'b' = \frac{w}{l}$,

$cd = \mathrm{L}'$, $c'd' = l'$, weight of $c'd' = w'$, and section of $c'd' = \frac{w'}{l'}$.

Then if we adopt the first proposition, and assume the second which is to be proved, $ab$, which of course varies directly as the length of $a'b'$, must vary inversely as its section, or L varies as $\frac{l}{\frac{w}{l}} = \frac{l^2}{w}$, or $\mathrm{L}w$ is as $l^2$; i. e. $\mathrm{L}w : \mathrm{L}'w' :: l^2 : l'^2$, and $l'^2\mathrm{L}w = l^2\mathrm{L}'w'$.

Now in the above experiment we shall find that

$$l'^2\mathrm{L}w : l^2\mathrm{L}'w' :: 705 : 704.$$

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* A minute space was left between the end of the tube and point of the pin, on account of the obstruction of the current by the latter. For a very accurate experiment, it would be better to pass the pin through the side of the tube, at a little distance from the end. It may be worth while to state, that at first very fine sewing needles were used in place of the pins, and with these none but a strong current would pass to the galvanometer. No attempt was made to amalgamate the steel points, but the brass pins were substituted at the suggestion of a friend, to whose kindness I am much indebted.

14. A weak current was purposely used to avoid generating, as far as practicable, unequal heat in the mercury cylinders, lest the conducting power of the two should be unequally affected. What degree of heat might have been generated, could not be ascertained in any of my experiments, but it was never sensible to the touch, though sometimes it appeared to be indicated by thermo-electric action, (§ 18.) The last experiment was repeated with two pairs of plates, though not with a very strong charge, and the result gave

$$l'^2 \mathrm{L}w : l^2 \mathrm{L}'w' :: 586 : 585.$$

Thus we have good evidence of the truth of our second proposition. It might seem at first sight that the whole law, including both the propositions, was proved by this experiment alone, but it will be readily seen that this is not necessarily true. The supposition, for instance, that in a given conductor the quantity is as the square root of the intensity, and in different conductors as the square root of the section, would explain as well as any other the result of the above experiment. It cannot, therefore, positively demonstrate one of the two propositions without the aid of the other, though it would certainly afford a strong probable support to both, and on this presumption, strengthened by these results with the *metals*, I may perhaps rest in the experiments I propose to make on conducting *fluids*, (§ 16.)

15. Any one in a situation to make accurate experiments, will find it easy to examine this law in the manner here described, with a degree of precision very far exceeding what I have attained. Conductors of very fine and uniform texture appear to be the principal desideratum. If these can be made perfect, I think that with a good galvanometer and considerable length of conductor, results may be obtained approaching even the exactness of geometrical measurements, and that an exceedingly minute deviation from the law, may, if it exist, be detected. Even if conductors cannot be made absolutely uniform, the corrections that ought to be applied to them, can be ascertained beforehand by comparing them with many other similar conductors, and taking a mean of the results. Should circumstances permit, I shall pursue the subject further hereafter, unless the occasion for doing so should be superseded.

16. The experiments I have described still leave room for doubt as to the application of the law in question to the case of

electrolytic conductors. On account of the peculiar relation of these bodies to metallic conductors, it is impossible to apply to them the same form of experiment that I have used with the metals. I have however set on foot such modified forms of experiment as my means will allow, but cannot complete them in time for this paper. Their success is doubtful on account of inherent difficulties, but if successful they may be communicated on some future occasion.*

17. A similar method of experiment to the above may be employed for the exact determination of the conducting power of metals, as also the variation of their conducting power with variations of temperature, and the general law, if any, which governs such variation, and other particulars. I have made a few experiments on conducting powers, but there was nothing of importance new in the results. A statement, however, made in this Journal† a few years since, that the conducting power of a wire was greatly impaired by bending or twisting it, was not confirmed. After winding and unwinding a thick wire several times over a cylinder less than an inch in diameter, the conducting power appeared scarcely affected, either in iron or brass wire.‡ So the annealing a hard iron wire at a low red heat affected its conducting power very little.

18. In the preliminary experiment on the uniformity of conduction in wire, the interference of thermo-electricity with the legitimate indications of the galvanometer was soon manifest. Such precautions however were taken, that in all the subsequent experiments no indications, or but doubtful ones, of thermo-electric action were perceived *when the battery was not in action.* But when the battery current was flowing, the indications of the galvanometer were subject to fluctuations, as if the points of equal tension were not quite stationary. These fluctuations, though confined within very narrow limits, and by no means sufficient to affect materially the results, were still manifest, and were as great near the soldered extremities of the wires as in the middle parts. They may therefore be referred to variable thermo-electric action between the wires and solder, in consequence of heat

* One of these experiments has been made since this was written, and the law found to hold in the case of dilute acid.

† See this Journal, first series, vol. xxxv, p. 109.

‡ A copper wire gave the same result, but it had been previously bent.

excited by the current. This was shown by doubling a wire so as to form two conductors joined at one end without solder, in which case the fluctuations disappeared at that end. This thermo-electric action, if constant, would not, however great, affect the accuracy of the experiment.

19. It is important to remember that the above law cannot, according to the present state of our knowledge, be generally applied to the case of momentary currents, such as the Leyden discharge, or the spark from the prime conductor of an electric machine, or induced currents at the making or breaking of a galvanic circuit. In such cases the induction of electric currents on themselves must interfere. If however we assume that at a constant distance the force of induction in a given length is proportional to the rate of increase or diminution of the current,* it will follow that two conductors of the same section but different lengths, will divide an electric discharge between them in the inverse ratio of their lengths, and in this case no error will be involved in the application of the law. But when we come to vary the section, it would probably be found to fail, the smaller section having the advantage. Or if the form only of the section were varied, in which case the advantage would probably be in favor of that which departed most from a circle.

20. The inquiry might arise whether these things should not be taken in view, in considering the theory of the discharges through telegraphic wires. The question in this case is whether the inductive action of the current on itself may not in those very long wires so much retard its increase as to prevent its assuming its maximum quantity during the time of a discharge by the key. Now if the assumption already made (§ 19) be true, it will follow that in a conductor of given section and conducting power, the time in which the current will reach its maximum under a constant electro-motive force will be independent, not only of the length of the conductor, but of the motive force itself. Indeed in mathematical strictness, the current would never reach its maximum under a constant motive force, but

* Prof. Henry, as is well known, supposes the induction of an electric current to last during its increase or diminution, and to be stronger as the increase or diminution is more rapid. His valuable papers on this subject may be found in volumes xxxviii and xli, of the first series of this Journal. See also Faraday's Researches, vol. i, p. 2.

would increase by increments forming in equal successive intervals of time, a descending geometrical progression,* of which the common ratio would be determined by the section and conducting power of the wire. If this is so, the induction of currents on themselves will no more interfere with the application of the law of conduction to the case of discharges through the telegraphic wires, than through the shorter conductors in ordinary experiments, and we may presume therefore that the effect of this induction is not appreciable in telegraphic discharges.

21. If in the register of Morse's telegraph the wire in the coil of the electro-magnet be supposed always to occupy the same space, and to be of constant weight, then according to Lenz's law the maximum effect on the electro-magnet ought to be obtained when the length and section of the wire of the coil are such as to make its resistance to conduction equal to that of the wire between the stations; and if this adjustment of the register to the distance of the stations could always be made, the intensity of battery required to work it ought to be, not as the distance itself, but as the square root of that distance. If it be found that the inductive reaction of the electro-magnet on the current prevents the latter from reaching its maximum during the period of discharge, the advantageous length of the wire of the coil would be less and its section greater than as determined by the above rule. It would still remain true, however, according to theory, that if the intensity of the battery varies as the square root of the distance, and the resistance to conduction of the wire of the coil have a constant ratio to that of the wire between the stations, the space of time in which the current will attain any given fractional part of its maximum, and the magnetic force developed in that time, will always be the same.

Yale College, January, 1846.

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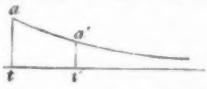
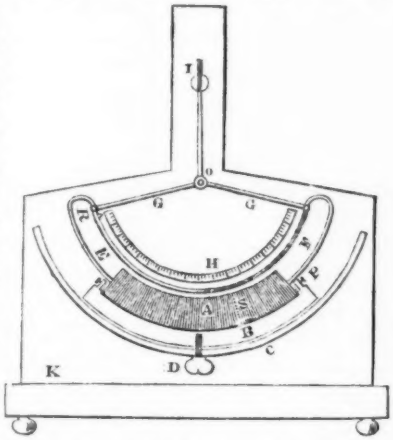
* This is strictly affirmed only with respect to a conductor in the form of a thin hollow cylinder. The law of increase in such a conductor may be shown by the logarithmic curve $aa'$. If time be represented by motion along the line $tt'$, and if $t$ represent the point of time at which the current begins, the space $tt'\,aa'$ may represent the quantity of the current at a point of time represented by $t'$. In a solid conductor this law must be a little modified, the increase of current being at first more and afterwards less rapid at the surface than in the central parts. But this does not affect the truth of the other facts stated.



ART. XI.—*Axial Galvanometer*; by CHARLES G. PAGE, M. D., Prof. Chem. and Pharm., Columb. Coll., Washington, D. C.

THE Galvanometer or Galvanoscope, as usually constructed, I have before stated is far from being a reliable instrument, for several distinct reasons. First, if the needle is not of the hardest steel, its power is constantly varying, under the influence of varying currents in the coil of wires. The magnetic force of the needle tends constantly to diminish, and the action of a powerful current is to give it an extra charge, and should its position be accidentally reversed, that is, be the reverse of that which it would assume under the action of the current, its polarity will be reversed, or its force much weakened. Any variation in the force of the needle during the course of investigation, must necessarily be productive of error in the results. Again, it is exceedingly difficult to render a needle perfectly astatic, or to divest it of local influences when the single needle is used. Again. in operating with high galvanic powers, the differences of deflection are almost imperceptible, and the estimates become exceedingly complicated. By substituting for the magnetized needle, a wire of soft iron, we gain in several particulars. First, the wire has no magnetic power, above that which is due to the retentive power of the soft iron, which may be considered as nearly a constant quantity. Second, the deflective force is not called into action, and therefore the observations are not complicated by fluctuations in the earth's action, or local forces. In using the galvanometer ordinarily, the degree of deflection is the difference between the earth's action, or the compound ratio of the earth's action and a local magnet, and the action of the galvanic current, or else the difference between the deflective force of the current upon an anastatic needle and the force of torsion. The axial galvanometer is sufficiently sensitive for most persons, is more delicate than I had anticipated, and it has the advantage of being rendered more or less sensitive at pleasure. In Vol. XLIX, p. 137, of the former series of this Journal, I gave an account of an axial galvanometer, in which it was necessary to use the spring balance to determine by weight the amount of forces. In the instrument now presented this difficulty is obviated, and the iron wire within the coil constitutes the balance itself. In the first form, the use of the spring or lever balance

involved much friction and unstableness. In the representation, the parts are of very different proportions from those of the instrument in actual use; the object of making the curves of such short radii being to contract the drawing. The coil of copper wire A is made upon a circular former, consisting of a bent rod about one fourth of an inch in diameter. The piece of soft iron wire E is less than one eighth of an inch in diameter, and is bent so as to be concentric with the coil. It is counterpoised by a brass wire F of similar form, and extending about half through the coil, the dividing line being shown half way. The soft iron wire should be of greater length than the coil, so that when the bend of the wire at R is in contact with the extremity of the coil, its ends should project some distance from the opposite extremity.




The extremities of the coil of wire are connected with binding screws P. The index point R shows upon the scale H the degree of force exerted, in absolute weight. The frame of soft iron and brass wires is braced and suspended by the wire rods G, G, the whole moving freely upon the centre O. Above this is raised a stem with a regulating weight, by which the sensitiveness of the instrument may be increased or diminished at pleasure. The coil is firmly secured to a concentric bed-piece or block B, which slides upon a concentric shelf or projection C, and is fixed at any desired point by means of the set screw D, passing through a slit in the shelf C. By moving the coil back or forth upon the slide, the sensitiveness of the instrument may also be diminished or increased at pleasure. The position of equilibrium between the coil and wire, is when the bend R of the wire is in contact with the coil, but the point of greatest action is when the extremities of the wire about coincide with the dotted line S. Therefore if the coil be so adjusted that this line shall be under the dividing line in the centre of the frame, the sensitiveness is at a maximum.

The capabilities of this instrument are obvious, and if the wire of the coil be fine and of considerable length, we are enabled to determine in a ready manner the relative powers of different orders of currents, and numbers of elements in the compound batteries. The power of the instrument may be much increased, by inserting the branch of the soft iron which is now without the coil, in another similar coil, but the construction would be a little more complicated. The two branches of the wire frame may be so put together as to be easily separable, for the introduction and trial of coils of various dimensions and sizes of wire; in which case the coils should all be made upon the same former, so as to present the same diameter of central opening.

Washington, January 16, 1846.

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ART. XII.—*Remarks on some Fossil Bones recently brought to New Orleans from Tennessee and from Texas;* by WILLIAM M. CARPENTER, M. D., Prof. in the Med. Coll. of Louisiana.

I. *Fossils from Tennessee—the "gigantic Fossil Man,"* (being the skeleton of a young mastodon.) Much interest has been recently excited by the announcement of the discovery in Tennessee of the remains of a man eighteen feet high. The papers teemed with accounts of the prodigy, and public confidence was secured by the assertion that the distinguished physicians of the west had testified that they were human remains. About the last of December these remains reached this city; and on the first of January I was requested by a distinguished surgeon here to go with him on the invitation of the proprietor to examine them, and give an opinion. They had been erected in a high room; the skeleton was sustained in its erect position by a large upright beam of timber. At a glance it was apparent that it was nothing more than the skeleton of a young *mastodon*, (one of Godman's Tetracaulodons, with sockets for four tusks.) The bones of the leg and ankle were complete, the metatarsal bones wanting. The bones of the anterior extremities complete to the metacarpal bones, which were present in one leg, the phalanges wanting. Most of the vertebræ were present; the ribs mostly of wood. The pelvic arrangement was entirely of wood; the scapulæ were present, but somewhat broken, and were rigged on with a most human-like elevation; pieces of ribs supplying the

want of clavicles. The osseous parts of the head were portions, nearly complete, of the upper and lower jaws. Some of the molars were quite complete; of the tusks, only one little stump remained, but the four alveoli of the upper jaw had large incisive looking wooden teeth fitted into them, and the lower jaw supplied to correspond. The cranium was entirely wanting from the lower margin of the orbits, back; but a raw-hide cranium was fitted on, which was much more becoming to the animal in his new capacity than the old one would have been.

The artificial construction was principally in the pelvis and head; and take it as thus built up, with its half human, half beast-like look, and its great hooked incisive teeth, it certainly must have conveyed to the ignorant spectator a most horrible idea of a hideous, diabolical giant, of which he no doubt dreamed for months. To one informed in such matters it really presented a most ludicrous figure.

The person who had it for exhibition was honest, I believe, in his convictions as to its being the remains of a man, having been confirmed in them by numerous physicians, whose certificates he had in his possession; and having asked and received my opinion, he determined to box it up, never to be exhibited again as the remains of a human being.

II. *Fossils from Texas.*—These fossils were collected by Mr. Wm. Huff from the banks of the Brassos river, near San Fillippe, I believe. They are now exhibiting in Mr. Cook's gallery of paintings in this city. Mr. Huff has been a resident of Texas since his boyhood, and has in the wild region of the western part of that state, acquired an ardent passion for the collection and study of fossils. By his kindness I have been permitted to make the following notes and drawings from his specimens. The fossils were all found in the same formation, which seems to have been a mixed clay, sand and gravel, with much iron.

1. *Fossil Ox.*—This specimen consists of the frontal bone, with portions of the bony nuclei of the horns. The frontal portion of the orbit of one eye is nearly entire; the margins of the other are broken. None of the bones of the lower portions of the head are left, being replaced by a conglomerate mass of sand and pebbles. The whole specimen is colored by oxide of iron, and a scaly incrustation of the same covers the frontal bone, except where the parts have cleaved off. The horns are similarly

colored, and the under side of each is encrusted with a hard ferruginous crust, in which quartzy pebbles are imbedded.

Fig. 1.

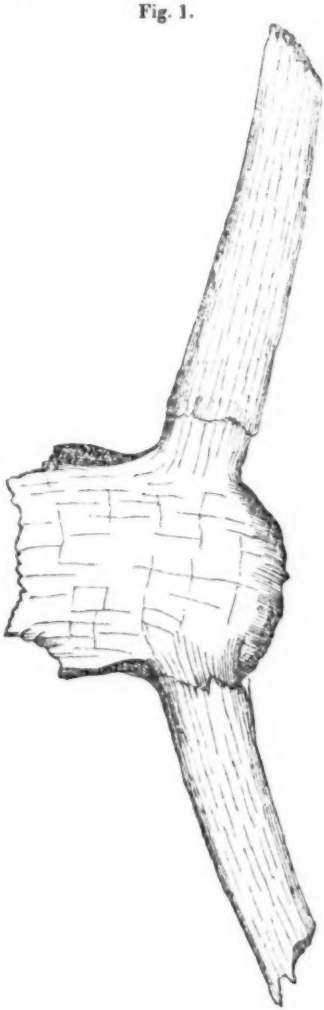


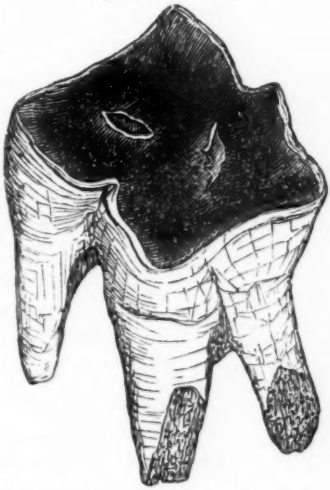
Fig. 1 represents this specimen, $\frac{1}{16}$th its linear dimensions. From tip to tip of the broken horns measures 56 inches; the right being 2 feet, and the left 18 inches long; the circumference of the nucleus of the horns at base is 17 inches, and at the distance of 18 inches from the head the circumference is 14½ inches. The frontal bone between the horns is 14 inches in breadth; between the external angles of the orbits 14¾ inches; between the internal angles of the orbits 11½ inches; and the length of the bone from the orbital to the occipital portion is 15 inches. The bones of the horns are nearly round, and they have a slight curvature upwards and forwards; and when entire, the bony parts must have measured, at a reasonable estimate, about 4 feet; and allowing the increase in length by the addition of the horny parts to have been only a foot, it would give a probable distance between the tips of the horns to be at least 11 feet.

The frontal bone is nearly plane anteriorly, and the horns arise laterally from a level with this plane; but the bone bulges about 2½ inches in the occipital portion above the horns, as shown in the figure.

Fig. 2 represents a tooth found with the head described above, but not attached to it, as the jaw bones were wanting. It is

the second true molar of the left upper jaw, (the fifth if the false molars are counted.) It deviates in some unimportant points from the ordinary form of this molar in the ox family. Its crown is much worn, and the internal segments of enamel are very small; in the anterior half, the segment is of an elongated oval form, while in the posterior half, the segment of enamel projects up in the form of a little crescent-shaped cutting edge, as I have endeavored to show in the sketch. In its greatest length the crown is 1·6 inches; and in its greatest breadth 1·2 inches.

Fig. 2—natural size.



The characters and dimensions of this tooth, and the fact of its having been found with the head, renders it almost certain that they belonged to the same individual, which was of gigantic size.

2. *Fossil Tapir.*—Previous to the year 1842, no undoubted fossil remains of the tapir had been described. Cuvier* described remains resembling those of the tapir family in the structure of the teeth; and his Lophiodon seems to have been a closely allied genus. In this country, remains have been described resembling those of the tapir, and have received the name of Tapiroid fossils.† In 1842 I described and figured‡ a tooth found in digging a well in the prairies near Opelousas, in this state. There could not arise a doubt that this tooth belonged to a tapir. Among the fossils brought from Texas by Mr. Huff, there are parts of both the upper and lower jaws of the same species as that found at Opelousas, and these have enabled me to confirm positively the opinion then advanced, that the tooth described was the fifth molar of the left lower jaw.

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* Ossemens Fossiles, vol. ii, p. 163, *et seq.*

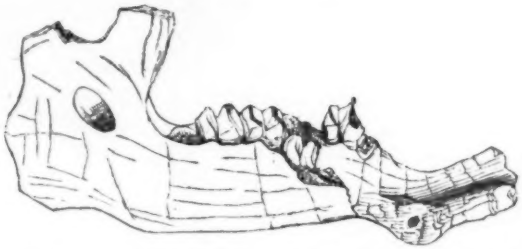
† Geological Transactions.

‡ American Journal of Science and Arts, vol. xlii, p. 390.

The following figures represent the specimens from Texas.

Fig. 3 represents the left half of the lower jaw, nearly complete. A portion of the posterior margin of the ascending branch is broken off; the condyle is broken off, but the process in part remains; the posterior molar is wanting; the third molar is with

Fig. 3—one third the natural size.



the jaw, but is loose, and being a deciduous tooth, was taken off in making the drawing, to show a young tooth which is growing up under it to replace it. There is a canine tooth on each side. Of the incisive teeth none remain, and the sockets of only the four middle ones can be seen, though it is probable that the two small lateral ones were present. The total number then would be six molars, one canine, and three incisive teeth on each side, making a total of twenty.

The presence of the canine teeth, the full number and replacement of the molars, show that the animal was just attaining to the adult age. All of the molars are considerably worn excepting the posterior one. That lying over the new one which was growing up, was very much worn.

The proportions and size of this jaw agree perfectly with those of the American tapir, as is shown by the following comparison between the measurements in the American, the present fossil, and the Indian tapir. The measurements are in inches and tenths of an inch. The measurements of the American and Sumatra tapirs are from Cuvier.*

| | American Tapir. | Fossil Tapir from Texas. | Tapir of Sumatra. |
|---|---|---|---|
| Length of the lower jaw, from the posterior part of the condyle to the margins of the incisive teeth, . . . . | 11·0 | 11·0 | 13·7 |
| Length from the posterior margin of the ascending branch of the lower jaw to the edges of the incisive teeth, . . | 12·0 | 11·8 | 15·2 |

* Ossemens Fossiles, vol. ii, p. 159.

As the incisive teeth, the condyle, and posterior margin of the ascending branch, are wanting in the Texas specimen, the measurement is only approximative; but there cannot be much error, as the data are sufficient to give a very certain result.

Fig. 4 represents the part of a left half of the upper jaw of a tapir, perhaps of the same individual, as the specimens were found within a few feet of each other. The teeth are represented from the inner side. They are the four posterior molars. On the outer side of the specimen, and arising from a point corresponding with the point of juncture of the two last molars, there remains a portion of the zygomatic arch. The two anterior molars are considerably worn, the third less so, and the posterior one not at all.

Fig. 4—$\frac{1}{4}$th size, lineally.*

3. Among the bones of this collection, are numerous fragmentary specimens of the bones of the mastodon and elephant. Those of the elephant, particularly of the teeth, are much more numerous than those of the mastodon.† There is one tusk of a mastodon which measures eleven feet in length, and twenty six inches in circumference in its largest part. It has a double curvature.

4. There are two claw-bones of one of the Megatherideæ, perhaps of the Oryctotherium?

5. There is likewise a very imperfect fragment of a skull, of very solid, hard, and heavy bone, which has been thick, and of a large cellular structure, especially at the occipital part of the head. The foramen magnum and condyles have been perpendicular to the basal bone, and to the direction of the base of the brain and the spinal column. The remains of the frontal portion of the head makes a large angle (perhaps 30°) with the basal bone. There is a well developed petrous bone on the right side of the head, the opposite one being wanting. The brain had numerous convolutions, as shown by the marks in the skull. The bone is perhaps thirteen or fourteen inches in length, and the cranial cavity would perhaps contain a quart. This cavity is of an oval shape, but narrowing rapidly forward. I can form no accurate

* Fig. 3, with which fig. 4 corresponds, is incorrectly printed one third, instead of one fourth, the natural size.

† I have remarked the same predominance of the elephant over the mastodon remains in collections made in Missouri.

idea of what it belonged to, but my impression is that it was some of the Cetacea. But to this opinion the objection may be offered that in the Cetacea the petrous bone is not fixed by bony union, as in this case. To the opinion that it might have been a small elephant, the objection occurred to me that in them the cranial cavity is as broad as it is long; and then again the cellular structure of the bone does not extend over the whole cranium as in the elephant, but is mainly limited to the posterior part above the back part of the cranial cavity.

Another curious specimen is a bone that appears to be part of a jaw bone, with small parts of the two rami. That is, it is the part in which the two bones met. It is concave on what I will call the inner side, and has a smooth, concave groove above. The front or chin portion is much broken, but contains two holes which appear to have been sockets for tusks. The fragment is about seven inches in each of its dimensions. The two sockets or holes are one inch and three fourths in diameter, perfectly straight, having the appearance of being drilled out, and about four inches deep; though they were much deeper before the other parts had been broken off. This I cannot refer to any known fossil species, unless it may have belonged to Dinotherium, or some such genus. The bone is light and friable.

New Orleans, La., January 14, 1846.

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## Art. XIII.—*Sequel to the Vestiges of Creation.**

In the few remarks upon the Vestiges which follow, we do not attempt to pursue the author through all the windings into which he has been led by the use of "the function of hypothesis."† The work has been so generally read, and so frequently reviewed in journals of all kinds, and with arguments so various, that we throw out only a few thoughts; and this, not in the way of denunciation, a style which has unworthily characterized some reviews, nor with the fear of truth that shows itself in many (not all) theological periodicals. The mind of man was put in action by the same being that set the universe in motion, and sooner or

* Explanations: Sequel to the Vestiges of Creation, by the Author of the same. American edition. Wiley & Putnam, 1846.

† Sequel to the Vestiges, p. 127.

later, to the extent of the mind's capabilities, truth will out. It becomes none who have faith in the revealed Word of God, to view science with a distrustful eye; they should rather unite their energies in its promotion.

Facts most surprising are daily coming to light, gradually widening our field of vision. The mysteries of one day are resolved into commonplace truths the next. The study of Nature, by direct observation, is thus preparing us for nearer and more glorious views of the great system of creation, and more exalted conceptions of its Author. Should the theory of the writer of the Vestiges be finally established, faith and religion would still stand immovable, supported by reason as well as the inspired Word. We may, however, reasonably doubt the speculations of a writer who denies the judgment of science, and endeavors by specious argument to withdraw himself from such a tribunal.*

The Sequel to the Vestiges reviews the ground passed over in the previous work, replying to the objections of its opponents, admitting some difficulties, and setting aside others. The style is fair and candid, and the subject is very skillfully managed. After some remarks on the nebular theory, the author proceeds to establish, by farther arguments and facts, the main point in his hypothesis; that there has been a progressive origin of the species, both in the animal and vegetable kingdoms; in other words, that the higher species in the scale of life, proceeded from those below by gradual development. The gradation observed among organic remains in the rocks of successive ages, is the grand fact appealed to.

That such a gradation may to some extent be perceived, is a fact generally admitted by geologists. Observations however do not bring to light the transition steps which the hypothesis demands. They indicate simply that at different periods, the orders of plants and animals were of a character fitted for the various conditions of the globe; and that as the earth was prepared for the higher orders, they appeared successively upon it. Of those orders which existed during the earlier periods, the species are often the most perfect which the history of organic life presents; and we even perceive in some instances a higher devel-

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* Sequel, pp. 123—127. "It must be before another tribunal that this new philosophy is to be truly and righteously judged."

opment, and more widely varied characters, than at the present time, as if to compensate by this mode of variation, for the small variety of distinct types and forms. Thus at one period, ferns predominated, to a large extent, over other forest trees; and the lizards of early times were less restricted in their habits, size, and specific characters, than those of the present era. The simple truth appears to be, that there was, as above stated, a general relation between the condition of the world and its productions, such animals living as were adapted to the peculiar temperature of the globe, the nature of its atmosphere and waters, and the disposition of the land.

Admitting the facts as brought forward by the Vestiges and its Sequel, nothing more than the above conclusion, could with propriety be deduced. Such a relation affords no evidence that the animals of one period originated from those of a preceding, by gradual improvement. This is one of those leaps in logic, especially favored by a large development of "the function of hypothesis." The author shows no necessary connection between the premises and his conclusions. Geology, if its facts mean any thing, fully shows that tribes of animals have successively disappeared, owing to physical causes; and that the new races have appeared by creation, and not by gradation, or "progress."

The *Acarus Crossii* is the basis upon which much of the argument in the Vestiges rests; and in the Sequel, the author has offered new evidence with regard to its galvanic origin. Acknowledging the fact, it proves too much. We have here an animal of the class Articulata, far above the infusoria and simple polyps in organization, produced by galvanism, without a gradual development successively through the lower grades. And if the germ of an Acarus may be thus made, without such a gradation of changes, why may not the germ of a mollusc, or of an insect, of a crab, fish or reptile? The germ in each case is a simple minute cellule, and certain favorable circumstances are all that is required for its development. Admitting this instance of galvanic creation, it might with more reason be argued that the germs in all instances were made by direct processes in nature, having been originated by the peculiar electrical conditions of the earth or other unknown circumstances. Such a theory would be a more correct deduction from the alleged fact; and it avoids the objection that the necessary shades of transitions between the

gradating species are not to be found represented in the rocks—as for instance, between the birds and kangaroos, fishes and reptiles. We look in vain among the greatest variations of species at the present time for any approximation to such an amount of change, and the trifling modifications detected, only surprise us at the small limits of variation. But we leave the *Acarus Crossii* and the theory it supports, to those who can believe in it.

If we mistake not, there is in the very nature of animal and vegetable life, evidence against the "theory of progress." An animal is a piece of mechanism of divine origin. As in the mechanisms of art, mechanical power is one result of its peculiar construction, which is exhibited through the thousand levers that may be set at work. Besides, there are chemical compositions and decompositions going on in every part, as another result of the powers within, or the battery of forces in action. By these means, the growth or sustentation of the animal takes place, and its physical energies are made manifest. But in addition to the compositions or reproductions going on throughout the system, there is another necessary result of its constitution, which is the reproduction of itself, or of germs equivalent to the same. This result is far beyond that of other reproductions in the system. In the latter, only cellular tissue, or muscular tissue, or some less highly organized animal product, is concerned. But here, all the elements of the parent are engaged, the nervous, cellular and muscular, to bring out a result equivalent to the parent. This reproduction is a consequence of the mechanism, and may be considered as, physically, its prime result; the animal forces within appear to have their point or points of concentration, and the same are the point or points of germ production.

Viewing an animal as thus constituted, have we any reason for believing that it can produce a result superior to, or essentially different from, itself? Its reproductions must be limited to the extent of its powers. It may give origin to mechanisms inferior to itself, as the reproduction of muscular fibre exemplifies; and perhaps the Entozoa (intestinal worms) may thus proceed through certain modifications. But can it accomplish a result beyond its energies? How can a baboon originate any thing above a baboon, with only a baboon's mechanism. The complete concentration of reproductive force takes place only in animals with a highly developed nervous system. As we descend in the scale,

the centres multiply, till in the lowest grades, with little but cellular tissue in their constitution, the possible centres are extremely numerous, and the ova as numerous. Throughout we find the proposition supported, that an animal cannot produce an animal of higher powers than itself.* These views, although not yet admitted among established facts, may lead us at least to look with much suspicion upon the "progress" theory of creation.

The Vestiges, notwithstanding some errors, has been, and will continue to be, of incalculable value to science and general knowledge. It has aroused the minds of the many indifferent to scientific investigation, to a spirit of inquiry and research, thus hastening the final establishment of truth.

## SCIENTIFIC INTELLIGENCE.

### I. Chemistry.

1. *On the Chemical Changes produced by the Action of the Solar Rays, or Actino-Chemistry;* by Robert Hunt, (Lon. and Ed. Phil. Mag., July, 1845, p. 25, and October, 1845, p. 276.)—At a meeting of the British Association at York, it was proposed by Sir John Herschel, that all those phenomena, which exhibit change of condition under the influence of the solar rays, should be distinguished, as forming a peculiar province of chemistry, and be designated by the term Actino-chemistry; this was generally approved by the chemical section.

Accordingly, the sun's rays are divided into those producing light, those producing heat, and those producing an *actinic* influence.

Mr. Hunt, in his experiments, confirms a fact first pointed out by Sir John Herschel, that the rays of the sun facilitate precipitation.

A solution of manganate of potash having been made in the dark, was placed in two glasses and set aside. After having been kept in darkness for two hours, the solutions remained as clear as at first. One of the vessels with its contents was then removed into the sunshine,

* It has been urged against the equivocal generation of Entozoa, that the production of the large ovaries they contain, were a waste of creative power, if the animals may be produced without the intervention of ova. Although not believing in their equivocal origin, we may express a doubt with regard to the validity of this argument. For the production of germs, if the above views be correct, is a necessary result of the animal mechanism; and their vast number is a consequence of the low order of the animal. The theory merely hinted at above, is drawn out at some length in Mr. Dana's work on Zoophytes, in a chapter treating of the growth of Zoophytes and of organic development in general.

when the solution immediately became cloudy, and was very speedily decomposed, the precipitate falling heavily. By experiments with the spectrum, the author found that the precipitation was due almost entirely to the most refrangible rays.

A few grains of sulphate of the protoxide of iron were dissolved in rain water; if kept in perfect darkness, the solution remained clear for a long time; it became, however, eventually cloudy and colored from the formation of some peroxide of iron, even in tubes hermetically sealed. A few minutes' exposure to the sunshine is sufficient to produce this change, and the oxide formed, instead of floating in the liquid, and as in the former case rendering it opaque, falls speedily to the bottom.

Mr. Hunt made some experiments, (particularly one with a mixture of the bichromate of potash and the sulphate of copper,) in which precipitation appears retarded by solar agency, and he is inclined to think that it will eventually be proved that the electric energy of the different bodies in relation to each other, will greatly modify the results obtained in these experiments.

The action of the sun's rays appears also to affect the color of the precipitates. If a solution of bichromate of potash is exposed to sunshine, it acquires a property of precipitating several metals as chromates, differing many shades in color from the colors produced by a solution similarly prepared and kept in the dark. If the actinized solution (solution exposed to sunshine) be poured into a solution of nitrate of silver, the chromate of silver formed is of a much more beautiful color than that given by a solution which has not been exposed to the sun's rays. The same is true when the salts of mercury are used.

Solutions of sulphate of iron exposed to sunshine, yield a Prussian blue, with the ferrocyanide of potassium, of a far more beautiful color than that produced by a solution which has not been so exposed.

Among other curious actions that the sun's rays exert, is the one by which it prevents electro-metallic precipitation. Place in a test tube a strong solution of nitrate of silver; in another tube, closed at one end by a thin piece of bladder, place a solution of iodide of potassium; this is supported in the solution of nitrate of silver by being fixed in a cork, and a piece of platinum wire is carried from one solution into the other. An arrangement of this kind being kept in the dark, iodine is soon liberated in the inner tube, and a crystalline arrangement of metallic silver is formed around the platinum one, in the outer. Another being placed in the sunshine, iodine will be liberated, but no silver deposited.

Mr. Hunt has examined at length the action of the sun's rays upon some photographic preparations, (the salts of silver,) with many curious

and interesting results, especially concerning the chloride of silver. Five grains of pure chloride of silver were put into a long test tube full of distilled water, and placed in the sunshine to darken, the powder being frequently moved, so that every part might be acted upon by the sun's rays. It was found, even after an exposure of a few minutes, that the water contained chlorine; (it became opaque on the addition of nitrate of silver;) and this was gradually increased as the chloride darkened. The darkening was continued for several hours, after which the solution was filtered to free it from chloride of silver, and nitrate of silver added to the filtered liquid; the chloride of silver precipitated, when collected and dried, weighed 1·4 grains on one occasion, 1 grain on another, and 1·5 grains on a third trial. From several other experiments on the chloride of silver, the author is inclined to believe that the first action of the solar rays is to liberate one half of the chlorine, which, moisture being present, is very readily replaced by oxygen. By the continued action of the exciting cause, the other proportional of the combined gaseous element is in like manner set free and replaced; and we now have oxide of silver, which in a short time is decomposed under the so called actinic power of the solar rays, and hence we have eventually nearly pure metallic silver in a state of extremely fine division. J. L. S.

2. *Effect of Cold on the Affinities of Substances.*—M. de Mareska has shown that sulphuric acid at —80° C. (—112° F.) no longer reddens tournesol, does not act upon the alkalies, the carbonates, iodide of potassium, nor chlorate of potassa. Phosphorus and arsenic react upon liquefied chlorine, surrounded by solid carbonic acid; and the same is true of ammonia. Bromine, iodine and sulphur, also, will combine with chlorine, though cooled to —80° C. or —90° C. Antimony in powder, put into liquid chlorine at —80° C. produces a disengagement of much heat and light; but there is no action, if the antimony be previously cooled down, or if dry chlorine gas be brought into contact with antimony placed in a tube inserted in solid carbonic acid. Potassium and sodium afford other examples of the same character.

3. *Electric Currents produced by the Vibration of Wires and Metallic Rods;* by W. Sullivan, (Phil. Mag., October, 1845, p. 261.) Mr. Sullivan, in his experiments on the electrical effect of vibration, took a piece of No. 15 brass wire, soldered it to a similar piece of iron wire, and stretched it over two uprights of a wooden frame, (about 18 inches apart,) so as to produce, when set in vibration, a musical note; the ends of this compound wire were then connected with an exceedingly delicate galvanometer; when in vibration a slight deviation of the needle took place, the direction of the current being from the iron to the brass, as in a similar thermo-electric circle. On

one or two occasions he noticed a deviation equal to that produced by heating the junction of the two wires to dull redness.

From some of the experiments, it would appear that when the wire vibrated continuously from end to end, the greatest effects were obtained; but when, from some cause, a nodal point was occasioned in the centre of the wire, and the two halves vibrated in the opposite direction, no effect was produced. As the amount of electricity developed by such means must be small, it was thought best to increase the masses set in vibration; and for this purpose, a bar of antimony five inches long, three eighths wide, and a quarter of an inch thick, was soldered end to end to a similar bar of bismuth; to the ends of the compound bar the wires of the galvanometer were attached. When suspended by a string, and set in vibration by striking with a piece of iron, results similar to the former were obtained, but of a more marked character; at times, considerable deviations were thus obtained, while very often no deviation whatever could be observed; the whole effect seeming to depend in some measure upon the manner in which the vibrations are propagated along the wire.

Two metals were not necessary to produce the effect, as a bar composed of crystalline hard iron and soft fibrous iron was capable of affording a current. J. L. S.

4. *Discovery of some new Earths in Zircons;* by L. Svanberg, (Chem. Gaz., October, 1845, p. 411.)—It has been discovered that zirconia, like the oxides of cerium and yttrium, is a mixture of several earths. The great difficulty attendant upon the separation of one from the other, has prevented M. Svanberg from studying their properties with a sufficient degree of accuracy. One of the earths which he found most abundant in the zircons from Norway, he has called *Noria*, from Nore, the old name of Norway. J. L. S.

5. *A new method of obtaining Chlorine;* by R. Oxland, (Chem. Gaz., October, 1845, p. 439.)—The process of manufacturing chlorine consists in a method of decomposing hydrochloric acid by means of atmospheric air. The hydrochloric acid gas and atmospheric air are mixed in the proportion of one measure of the former to two of the latter; and the mixture is passed through an air-tight furnace, kept at a bright red heat. The decomposing furnace is so arranged that the fire passes over the arch and under the bed;—the furnace is filled with pieces of pumice-stone, and the gas and air enter at the end farthest from the fire, and pass out at the other end through a pipe at the upper part of the furnace. The products resulting from the mixture passing through the decomposing furnace, consist of chlorine, associated with undecomposed muriatic acid, and any excess of atmospheric air and nitrogen. The mixture is cooled by passing through a series of

earthen tubes surrounded by water, after which, the hydrochloric acid is effectually separated by passing the mixture through water; and finally, the chlorine is obtained, and chloride of lime produced by passing the residuary mixture into the ordinary lime condenser, where the chlorine is absorbed, and the nitrogen and atmospheric air remaining are allowed to pass off. J. L. S.

6. *On the Solubility of the Basic Phosphate of Magnesia and Ammonia, and on the quantitative determination of Phosphoric Acid and Magnesia by means of this salt;* by Dr. R. FRESENIUS, (Annalen der Chem. und Pharm., July, 1845, p. 109.)—Chemists have been careful about washing this salt thoroughly, when used as a means of estimating magnesia quantitatively, on account of its supposed solubility. But in fact, when the salt is washed with water containing ammonia, hardly a trace of it will pass through the filter. One part of the ammoniomagnesian phosphate requires 44,330 parts of ammoniacal water for solution; which is equivalent to one part of magnesia in 120,760 parts, and one part phosphoric acid in 70,000 parts.

In estimating magnesia, it is well not to have too great an excess of ammoniacal salts in solution, and to wash the precipitates with ammoniacal water, until the water that passes through, leaves no residue when evaporated on a bit of platinum foil. The salt can be made use of as an accurate means of estimating phosphoric acid quantitatively, even when the acid is in combination with iron or alumina.

To analyze the phosphate of iron and alumina, first dissolve in muriatic acid, then add tartaric acid, and lastly, an excess of ammonia, until the whole of the precipitate that is first formed is redissolved; now add sulphate of magnesia, when the double salt in question will be precipitated—at the expiration of twelve hours, filter, wash with ammoniacal water, dry and ignite the filter and its contents, from the weight of which the phosphoric acid may now be calculated. In one experiment made with an artificial mixture of the phosphates of iron and alumina, this method indicated 20·14 per cent., when the quantity calculated to be present was 19·91. J. L. S.

7. *The decomposition of Water by Metals, promoted by the presence of Acids or Salts;* (Comptes Rendus, July, 1845, p. 37.)—This subject has been extensively investigated by M. MILLON, and with highly interesting results. The rapidity of decomposition is sometimes increased a hundred fold, even by a minute quantity of certain salts. Pure zinc in dilute sulphuric acid, remains with little or no action, but on adding a small quantity of certain salts, decomposition commences at once, and hydrogen is evolved, though differing in the amount of action with the different salts used. Thus, if the action of pure dilute sulphuric acid is represented by 1, that of the bichloride of platinum is

149—of arsenous acid, 123—of sulphate of copper, 45—tartar emetic, 29—sulphate of silver, 24; and so with many other salts.

With very dilute muriatic acid, (1 to 40 of water,) the action is as follows: for bichloride of platinum, 43—arsenous acid, 38—tartar emetic, 35.

A solution of oxalic acid has no action on zinc, even when heated; but with a few drops of bichloride of platinum, the whole is soon converted into oxalate. The action of acetic acid is hastened by the same chloride, and also of tartaric and citric acids, diluted with four or five times their weight of water.

This addition of a salt, sometimes changes the result. Nitric acid, with $4\frac{1}{2}$ equivalents of water, and diluted with two or three times its volume of water, poured on iron filings, causes a solution of the iron and the evolution of nitrous acid. But if only one drop of bichloride of platinum be added, hydrogen is evolved in place of nitrous acid, and protonitrate of iron with nitrate of ammonia are formed.

Bismuth, silver and mercury do not decompose water under any circumstances. Copper, in contact with bichloride of platinum and dilute hydrochloric acid, heated, gives off hydrogen freely; but the same chloride arrests at once the action of nitric acid.

These experiments were extended to other metals with equally important results. J. L. S.

8. *Action of the Alkalies on the Protosalts of Mercury;* (Jour. de Pharm., July, 1845.)—M. J. Lefort confirms the announcement of M. Guibourt, that the protonitrate and protochloride of mercury, mixed with caustic potash and soda, yield metallic mercury and the binoxide, in place of the protoxyd. The same is true of the carbonate, oxalate, iodate and acetate. J. L. S.

9. *Preparation of Iodic Acid;* (Chemist, July, 1845, from Liebig's Jahresb., April, 1845.)—M. Millon prepares iodic acid by mixing iodine and chlorate of potash, and heating, with water and a little nitric acid, until a rapid disengagement of chlorine takes place. In a short time the iodine is completely oxidized. The acid formed is precipitated by baryta, and separated again by sulphuric acid.

J. L. S.

10. *Oxidation by means of Cyanogen;* by M. P. C. Boudault, (Jour. de Pharm. et de Chim., June, 1845.)—Cyanogen, from its similarity to chlorine, bromine and iodine, might be supposed to possess the indirect oxidizing power of these agents. This M. Boudault has found to be the case, but owing to the instability of free cyanogen when dissolved in water, the experiments were made with one of the cyanogen compounds, in which the cyanogen was not in a strong state of combination, as is the case with the ferricyanide of potassium, or red

prussiate of potash. The oxides of manganese, nickel, cobalt, lead, copper and tin, in solution, are all peroxidized by having added to them a mixed solution of potash and ferricyanide of potassium, which last is converted into the ferrocyanide. The oxide of chrome, when dissolved in potash and boiled with the ferricyanide of potassium, is converted into chromate of potash, and if sufficient oxide be present, all the ferricyanide is converted into the ferrocyanide. Sulphur is oxidized by it, being converted into sulphuric acid; the same is true of phosphorous and sulphurous acids and their salts. Oxalic acid and the oxalates are instantly converted into carbonates, by being added to the solution of potash and ferricyanide. J. L. S.

11. *Action of the Bicarbonates of the Alkalies on the Vegetable Bases when Tartaric Acid is present;* by C. OPPERMANN, (Comptes Rendus, October, 1845, p. 810.)—It is well known that the presence of tartaric acid in solutions of the metallic salts, prevents their precipitation by an excess of ammonia and other reagents. M. Oppermann has found in his experiments, that when tartaric acid is present, sufficient to produce decided acid reaction, the salts of morphine are not precipitated by the bicarbonates, while those of narcotine are; the salts of strychnine are precipitated, and those of brucine not; the salts of cinchonine are precipitated, those of quinine not; the salts of veratrine acidified in the way mentioned, are precipitated by the bicarbonate of soda, but not by the bicarbonate of potash. The solutions of the salts were made with 1 part to 200 or 500 of water. It is seen by this, that where a plant contains two bases, the tartaric acid prevents the precipitation of one, but not of the other, a fact which may be taken advantage of in separating the two bases. J. L. S.

12. *On a new method of forming Chloral;* by M. STADLER, (Comp. Rendus, October, 1845, p. 820.)—The reaction of chlorine in its nascent state upon many organic substances, is found to produce chloral; starch, however, has been preferred. It is obtained mixed with formic acid and an oily body, which now occupies the attention of M. Städler, and which is procured by submitting to distillation a mixture of starch, binoxide of manganese, and hydrochloric acid. J. L. S.

13. *Quantitative determination of Lithia;* by C. RAMMELSBERG, (Chem. Gaz., December, 1845, p. 502, from Pogg. Annalen, 1845.)—When lithia and soda occur together, as is usually the case, there is, as is well known, no other method of estimating, except by precipitating the first in the form of a phosphate of soda and lithia, or by the arithmetical method of indirect analysis, first employed in chemistry by Richter. Both processes are undoubtedly imperfect, especially the first. Rammelsberg has found, after numerous experiments on various salts, that a mixture of alcohol and ether may be employed for the separation of

the chloride of sodium and chloride of lithium, with very satisfactory results; the latter salt being dissolved in this mixture. J. L. S.

14. *On the estimation of Fluorine;* by F. WÖHLER, (Chem. Gaz., 1845, p. 403, from Pogg. Annalen, 1845.)—The weighed substance is intimately mixed with pure silica, unless it already contains this ingredient; the mixture is placed in a small flask, which can be weighed; very concentrated sulphuric acid, which has been boiled, is added, and the flask quickly closed with a cork, through which a small tube passes, that is filled with fused chloride of calcium, and drawn out to a point. The whole apparatus is now weighed, and then exposed to a proper heat as long as gaseous fluoride of silicon is evolved. The last portions are removed by exhaustion under the receiver of an air-pump. The loss in weight which it experiences is fluoride of silicon, from which the amount of fluorine is calculated. 1·395 parts of fluoride of silicon are formed for each part of fluorine. To test this method, the author estimated the amount of fluorine in fluor spar, and the results were accurate to the first decimal place. Care must be taken that no carbonates are present. J. L. S.

15. *Sulphurous Ether;* by MM. EBELMAN and BOUQUET, (Comptes Rendus, May, 1845.)—Sulphurous ether is formed by adding absolute alcohol by degrees to the protochloride of sulphur, until all action ceases; then distill the mixture—the first product that passes over is alcohol, acidulated by hydrochloric acid; but when the temperature of the liquid reaches 300°, the product in question begins to come over, and must be collected separately. It must be rectified until its boiling point remains constant. It is colorless, possessing an odor somewhat like mint; its taste is first cooling, then burning; it boils at 322° F.—dissolves in alcohol and ether, and is heavier than water, its density being 1·085. Composition $SO^2\ C^4\ H^5\ O$. J. L. S.

16. *Production of Diaphanous Quartz and Hydrophane;* by M. EBELMAN, (Comptes Rendus, August, 1845, p. 502.—When either of the two silicic ethers (see Am. Jour. Sci., July, 1845, p. 195) is exposed to the prolonged action of a moist atmosphere, the liquid solidifies to a transparent mass, which ultimately becomes hard, and has the lustre, fracture, and transparency of the most limpid rock crystal; its density is 1·77. It is a hydrate, having for its formula $(Si\ O)^2\ HO$.

One condition necessary to produce this substance, is to allow the moist air to enter by a very small opening, to produce a very slow contraction and solidification. If the silicic ether employed retains a little chloride of silicon, which happens when an excess of alcohol has not been employed in the preparation of the ether, the quartz formed assumes the appearance of *hydrophane*, instead of being diaphanous: the greater the impurity, the greater the opacity. This hydrophane

readily becomes transparent when placed in water. Almost any foreign substance present suffices to determine the quartz to assume the character of hydrophane. J. L. S.

17. *Test for Manganese;* by WALTER CRUM, (Annalen der Chem. und Pharm., August, 1845, p. 219.)—If peroxyd of lead be heated with dilute nitric acid, and there be added to it a solution of manganese, the liquid acquires the purplish-red color of permanganic acid, which is readily perceived as soon as the excess of peroxide has subsided. This is an extremely delicate test—by means of it a white marble was found to contain manganese. J. L. S.

18. *Valerianic Acid;* (from the Chem. Gazette, January 1, 1846, p. 9.)—The berries of the Viburnum opulus afford a volatile acid, which was called *phocenic* acid, by Chevreul, but afterwards was shown by Dumas to be identical with valerianic acid. L. von Monro has confirmed the view of Dumas.

19. *Atomic weight of Uranium;* (Pogg. Ann., lxvi, 91, 1845.)—Experiments by RAMMELSBERG, go to show that the weight of uranium is between 725 and 750, thus confirming the results of Wertheim and Ebelman, the former of whom obtained the number 746·36, by the analysis of the crystallized acetate of soda and uranium, and the latter 742·875, from the oxalate of uranium.

20. *Eudiometry;* (Chem. Gaz., January 1, 1846, p. 23.)—Prof. GRAHAM recommends, for the rapid absorption of oxygen in the eudiometric process, a solution in ammonia of a sulphate of the suboxide of copper and ammonia. This salt falls as a brown powder when a stream of sulphurous acid gas is conveyed into a cold solution of the ammoniacal sulphate of copper. When dissolved in ammonia, it absorbs oxygen with singular avidity; and when employed in this form in eudiometry, gives results of considerable uniformity.

21. *Detection of Poisons by Physiological Tests;* (Buchner's Report, xxxvii, 3, and Chemist, July, 1845, p. 316.)—The eye is so delicate a test for atropine, (the alkaline principle of belladonna,) that, according to Rieck, $\frac{1}{100}$ of a grain dissolved in water and applied to the eye of a rabbit, produces dilatation of the pupil; and even $\frac{1}{1000}$ of a grain, after having been twice applied to the eye, produces the same effect. Runge found that this alkaloid, as well as hyoscyamine, is evacuated by the urinary organs, and that the urine of rabbits, after they had taken either belladonna, stramonium or hyoscyamus, on being applied to the eyes of other animals, invariably produced a dilatation of the pupil.

It is known that strychnine and brucine are distinguished from all other alkaloids by the fact, that on being applied in very small quantities to a vein or fresh wound, they produce most violent irritation of

the spinal marrow and motory nerves, accompanied with tetanic fits; this physiological fact may be made available in the detection of nux vomica or strychnine.

W. Arnold found that a living frog was the most delicate test for it; he ascertained that tetanus was produced in thirteen minutes after the introduction into a wound in the back, of the $\frac{1}{100000}$ of a grain of strychnine rubbed up with sugar of milk, and even the $\frac{1}{1000000}$ of a grain of the same narcotic, increased to a certain extent the irritability of the frog, after the lapse of half an hour or more.

Having in one of his experiments employed a frog, which, on the preceding day, had suffered from tetanus in consequence of a dose of $\frac{1}{100000}$ of a grain of strychnine, he found that in this animal $\frac{1}{1000000}$ of a grain produced tetanus, lasting for several hours and proving fatal.

It is also recommended to make use of the paralyzing effect of certain other narcotics (morphine, nicotine and cyanogen) upon the action of the heart of the frog, laid bare, as a means of deciding on their presence. J. L. S.

22. *Urinary Calculus*, (Chem. Gaz., November, 1845, p. 468, from Archiv. für Phys. und Prakt. Chem., 1845.)—Urostealite is the name given to a new calculus, by M. Heller, which was detected in the urine of a patient under his charge. It fuses, when heated strongly on a platinum foil, burns rapidly, and diffuses a strong but agreeable odor, which most resembles that of shell-lac and benzoin. It dissolves in ether, and also in warm alcohol. J. L. S.

23. *On the Milk of Carnivora;* by M. Dumas, (Comptes Rendus, September, 1845.)—The method by which the milk was analyzed is given in detail. If it be required to test for the sugar only, all that is necessary is to coagulate the boiling milk with a little acetic acid, evaporate nearly to dryness, (this had better be done under the receiver of an air-pump,) and the extract, which will have a gummy consistency, after standing for some time, yields crystals of sugar of milk, if it be present.

As a type of the milk of carnivorous animals, M. Dumas employed that of dogs fed upon flesh. He ascertained that in no instance was sugar present, nor could a trace of butyric acid be detected in the milk of dogs, after feeding them for fifteen days on flesh. Whereas, if the same dogs were fed upon farinaceous food, sugar was invariably detected, as well as butyric acid; (this acid, M. Pelouze pointed out a short time ago, was readily formed by fermenting sugar with casein.)

This author thinks that the fatty globules in milk are surrounded by casein, for when ether is shaken with milk, it will after some time separate from it, leaving the milk with all its original characters, while the ether will be found to contain no fatty matter. If we first add acetic

acid, then boil the milk, allow it to cool, and shake it with ether, all the fatty matter will be taken up. J. L. S.

24. *Composition of the Urine of Herbivorous Animals;* by M. BOUSSINGAULT, (Annales de Chim. et de Phys., Sept. 1845, p. 97.)—The details of these analyses are given at length, but all that can be presented here is a statement of the results.

| | Urine of Hog, fed on potatoes. | Urine of Cow. | Urine of Horse. |
|---|---|---|---|
| Urea, | 4·90 | 18·49 | 31·00 |
| Bicarbonate of potash, | 10·74 | 16·12 | 15·50 |
| Carbonate of magnesia, | 0·87 | 4·74 | 4·16 |
| Carbonate of lime, | traces | 0·55 | 10·82 |
| Sulphate of potash, | 1·98 | 3·60 | 1·18 |
| Phosphate of potash, | 1·02 | | |
| Chloride of sodium, | 1·28 | 1·52 | 0·74 |
| Lactate of an alkali, | undetermined. | | |
| Silica, | 0·07 | traces | 1·01 |
| Hippurate of potash, | | 16·51 | 4·74 |
| Lactate of potash, | | 17·16 | 11·28 |
| Lactate of soda, | | | 8·81 |
| Water or Organic matter, | 979·14 | 921·32 | 910·76 |
| | 1000·00 | 1000·00 | 1000·00 |

In the urine of the hog, no hippuric acid was detected. M. B. thinks it may have been owing to the exclusive nature of the diet. No phosphates were detected in the urine either of the cow or horse. J. L. S.

25. *Researches on the Composition of the Yolk of Egg;* by M. GOBLEY, (Comptes Rendus, Sept., 1845.)—These researches have been attended with two curious results.

1st. The discovery of a new acid not before known to exist in the animal economy, and but just produced artificially by M. Pelouze—the *phospho-glyceric acid*, (a compound acid of glycerine and phosphoric acid.) This acid in the yolk is in combination with ammonia.

2d. The discovery of margaric and oleic acids in combination with ammonia is a curious physiological fact, for hitherto the acids have only been found in combination with glycerine or with soda, in animal products. J. L. S.

26. *Water from the Artesian Well of Grenelle, at Paris,* (Chemist, July, 1845, from Med. Gaz., June, 1845.)—The Artesian well at Grenelle is the deepest but one in the world,* extending down 1794 feet, traversing chalk in the greater part of its course. Its temperature is 82°

* The well of Mondrof is over 2200 feet deep, and they are still boring. It requires 3 hours to draw up the augur. The well is 1 foot diameter at the mouth, and 7 inches at the bottom. The water rises with a temperature of 95° Fahr.

F., which is 31° F. above the mean temperature of Paris. It rises 40 to 50 feet above the surface, and is discharged at the rate of 600 gallons per minute. 100.000 parts, after filtration, contained carbonate of lime 6·80, carbonate of magnesia 1·42, bicarbonate of potash 2·96, sulphate of potash 1·20, chloride of potassium 1·09, silica 0·57, organic azotized matter 0·26. J. L. S.

27. *Ancient Coins.*—M. MOESSARD has analyzed seven kinds of ancient coins, and finds them to consist of copper and tin, with occasionally a little silver, or traces of arsenic.

28. *Varnish for Eggs, Crabs, Insects, &c.*—Dissolve gum arabic 4 oz., and gum tragacanth ½ oz., in 3 pints of water, add to the solution 20 grains of corrosive sublimate and 20 drops of oil of thyma dissolved in 4 oz. spirits of wine, mix well and let it stand a few days to separate: the clearer part is to be used as varnish, the thicker as cement.

29. *Goadby's solution*, for the preservation of specimens of soft animals without bones or shells, consists of *corrosive sublimate* 4 grains, *alum* 2 oz., *common salt* 4 oz., *water* 1 quart. Specimens should first be steeped in equal parts of water and this solution, and then put into the solution itself. It is recommended as the only material by which Medusæ can be preserved.

30. *Freezing of Water by the Air Pump, without the aid of Sulphuric Acid or any other desiccating agent;* by J. LAWRENCE SMITH, (communicated by the author.)—In attempting to freeze water under the air-pump, without the aid of a desiccating agent, the cooling of the water to the point of congelation is prevented by the heat received from the containing vessel. I have lately found that by obviating this difficulty, water may be readily frozen by its own evaporation.

It was first shown by Count Rumford, that water does not wet a sooted surface, but forms in globules, like quicksilver. Three drops of water were placed in a sooted watch-glass; the spheroidal globule lay on the soot, exposing a large surface for evaporation, at the same time that the water was insulated from any source of heat. Arranged in this manner and placed under an air-pump, two or three minutes were sufficient to freeze the water. The glass was sooted over an oil lamp with great care; the experiment fails if the globule of water touches the glass even by a small point.

In place of the sooted watch-glass, make a shallow cavity in the end of a large cork, and over a lamp, burn it, sooting it at the same time. By putting three drops of water into the cavity thus prepared, and subjecting it to the action of the air-pump under a pint receiver, the water froze solid in a minute and a half; and in two and three fourths minutes, 20 grains of water congealed, though at 73° Fahr. when introduced. Under a receiver of three quarts capacity, 20 grains of water

froze in four minutes. I could not succeed in freezing the same amount in the sooted watch-glass.

By placing corks, prepared as above, over a saucer of sulphuric acid, the same results are obtained more rapidly. I put half a drachm of water, at 65° Fahr., in each cavity, and exhausted the receiver till the mercurial gauge reached $\frac{4}{10}$ of an inch, which was effected in one minute. In a minute and a half, the water on one cork began to freeze, and in five minutes they were all frozen. An ounce of water, in a large flat cavity, froze in $3\frac{1}{2}$ minutes.

A flat-bottom porcelain capsule was prepared for an experiment on a large scale, by sooting it in the following manner. After coating it with soot over a lamp, and allowing it to cool a little, a small quantity of oil of turpentine was carefully poured upon the edge and passed over the entire surface; the vessel was then warmed to drive off the redundant turpentine. The surface was again coated with soot, and again with turpentine, and this process was repeated a third time; finally, another coating of soot was added, when it was ready for use. Two ounces of water were placed in this capsule under a receiver, and the air-pump worked for one minute. After standing six minutes, the surface was frozen.

This experiment, as well as similar ones, was attended with violent ebullition on the part of the liquid, throwing the water against the sides of the receiver, which was owing to the rapid formation of vapor on the under surface of the liquid.

## II. Mineralogy and Geology.

1. *Chloanthite, a new Binarseniet of Nickel;* by A. Breithaupt.—This ore is from Schneeberg in Saxony. It differs from white nickel pyrites, in its tesseral crystallization with cubic cleavage. Specific gravity 6·423—6·565. Hardness $6\frac{1}{2}$—7. Color tin white. Composition, according to Mr. Booth, nickel 20·74, cobalt 3·37, iron 3·25, arsenic 72·64. (See this Journal, vol. xlvii, 351, and xxix, 242.)

2. *Cuban of Breithaupt;* (Pogg. Annalen, lxiv, 280, 1845.)—The mineral cuban, consists, according to C. H. Scheidauer, of sulphur 34·78, iron 42·51, copper 22·96, with a trace of lead, affording the formula $\dot{Fe}^2+\dot{Cu}$.

3. *Kyrosite of Breithaupt;* (Pogg. Annalen, lxiv, 282, 1845.)—Scheidhauer obtains for the composition of kyrosite, sulphur 53·05, iron 45·60, copper 1·41, arsenic 0·93, which, excluding the copper and arsenic, is the composition of common sulphuret of iron.

4. *Turquois in Silesia;* (Pogg. Annalen, lxiv, 633, 1845.)—A new locality of this mineral near Domsdorf, in Silesia, is announced by E. F. Glocker. The color is in part a light apple green, and part be-

tween apple and grass green. It occurs in incrustations of small accretionary cylindrical stems.

5. *Crystalline form of Geocronite;* (Poggend. Annalen, lxv, 302, 1845.)—Crystals of Geocronite, from the Val di Costello, have an oblique rhombic primary, the lateral angle of which is 153°. They occur under the form of a six-sided prism, terminated in four-sided pyramids; one of the angles of the pyramid is 122°. The composition determined by T. Kerndt, is very similar to that obtained by Svanberg.

6. *Piauzite, a new mineral;* (L'Institut, Nov. 1845, No. 619, p. 400.)—M. HAIDINGER has detected a new resin near Neustadt, at Piauze. It is compact, with a slightly conchoidal fracture, brownish black color, and feebly translucent on the edges. Its density is 1·220, and it fuses at 515° C., burning with a brilliant flame, and a slightly aromatic odor. It dissolves completely in ether and a solution of caustic potash, and also almost entirely in *absolute* alcohol.

7. *Dysclasite.*—The primary form of the crystals of this mineral, as determined by Breithaupt, is a right rhombic prism of 122° 19′.

This mineral has been lately found abundantly, in a massive state, at Copper Harbor, Lake Superior.

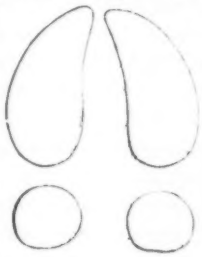
8. *Columbite and Wolfram;* (Pogg. Annalen, lxiv, 171, 1845.)—G. ROSE, in his investigations of these minerals, has detected a close similarity in the forms and angles of their crystals, showing that they belong to the same system, and are approximately isomorphous. Three angles in Columbite have the values 100° 40′, 97° 29′, and 93° 16′, and the corresponding in Wolfram are 101° 5′, 99° 12′, 91° 54′. The cleavage is similar in direction in the two minerals, but is more perfect in Wolfram. The facts indicate that oxyd of niobium, which is contained in the Columbite, is isomorphous with oxyd of tungsten.

9. *Trichroism of Crystals;* (Poggend. Annalen, lxv, 1, 1845.)—M. HAIDINGER, in an elaborate memoir on the pleochroism of crystals, after describing at length instances of dichroism, and their peculiarities, enters into a consideration of the transmitted colors of crystals with three unequal axes, which he shows to afford instances of trichroism. The colors are observed either in the line of the axes, or perpendicular to the faces, and often appear different in six directions. Iolite, though called *dichroite*, is an example of this trichroism.

10. *Phosphorescence of the Diamond.*—P. RIESS, experimenting on the phosphorescence of a large number of diamonds, found that in many of them, an exposure of half a minute to the sun's rays, caused them to give out light for fifteen to twenty minutes, on being removed into the dark. The phosphorescence produced by the red rays, continued longer than that from any other of the colors.

11. *Footprints in the Coal Rocks of Westmoreland Co., Pennsylvania;* by A. T. KING.*—About 27 miles from this town, (Greensburgh,) on the summit of Chestnut ridge, one of the principal axes of elevation of the Alleghany range, are numerous imprints, which are very anomalous and remarkable. The greater number have much resemblance to the tracks of cloven-footed ruminant mammals. They are of various sizes, and differ from most living types, in having had heel-like prominences, which made impressions from 1 to 2 inches behind the main tracks.

The length of the largest track, including the posterior impressions, is 8 inches, and the breadth 5 inches. The smaller ones vary from $4\frac{1}{2}$ to $5\frac{1}{2}$ inches in length, by $3\frac{1}{2}$ to $4\frac{1}{2}$ in breadth. The general form is ovoidal, the largest part being behind, as well as the widest part of the cleft. The posterior imprints in the largest tracks, are each about the size of a walnut. There are five large and eight small tracks, in continuous lines, which are tolerably perfect, and many others which are much defaced. The imprints vary from $1\frac{1}{2}$ to $2\frac{1}{2}$ feet apart.



Besides these, there are from four to six huge tracks of a different character, and possibly Batrachian. They are in a continuous line, and each imprint is 13 inches long and 9 wide. There are 5 toes from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches in length, and the second of them is the longest.

The average distance between the tracks is 3 feet 7 inches, with the exception of the last two, which are 7 feet apart. This seems to indicate that there was at one time a track between, which has been since obliterated.

12. *The Mastodon of Newburg, N. Y., discovered in August*, 1845.—Our readers are acquainted with the fact, that a noble specimen of the great American mastodon was exhumed in the month of August last, in the town of Newburg, N. Y. In regard to the state of preser-

* The facts below are published in the Proceedings of the Academy of Natural Sciences, at Philadelphia, for Nov. and Dec. 1845, p. 299.

vation of the bones, the completeness of the skeleton, and perhaps its size, this is the most perfect which has yet been discovered. The bones contain a large portion of their gelatine, are firm in texture, light in color, and sonorous when struck. The number of bones found is sufficient to complete the skeleton with very slight exceptions, and to give a true idea of the osseous fabric of the animal. Some of the caudal vertebræ and a few bones of the feet only are missing, but those wanting in one foot exist in the other, both in the anterior and posterior extremity. As to size, its actual height cannot at present be stated with precision; the length of the head however is three feet, and the breadth of the pelvis six feet. The tusks when discovered were ten feet long; but a portion about four feet in length only of each tusk is well preserved: of the remainder, about four feet retains its form, the rest is decomposed. A very interesting fact in this specimen is the existence of an incisor tooth, or tusk, in the lower jaw on the left side, and the traces of the socket of another on the right.

This magnificent relic of a lost race is now insured to our country and its scientific resources, by having become the property of Dr. John C. Warren of Boston, Professor of Anatomy, &c. in Harvard University. The skeleton has been taken to pieces, and is now in process of re-articulation with the aid of all the light of comparative anatomy derived from scientific men, and from the skeletons of the elephant, tapir, and other pachydermatous animals. Every effort will be made, we are informed, to place the different parts in a strictly anatomical relation, and without any attempt to exaggerate the surprising dimensions of the animal. When set up, and protected from decomposition, it will be open to the inspection of men of science of this and foreign countries.

It is a little remarkable, that in the summer of 1844 a mastodon skeleton was discovered in New Jersey, which was at the period of its discovery more perfect than any other. The whole number of articulated mastodon skeletons which previously existed, was, we believe, only three, viz. Mr. Peale's in Philadelphia, and that in Baltimore, found in Newburg in 1802, and Dr. Koch's Missourium, in the British Museum, found in 1840. That of New Jersey was much more complete than those just mentioned; but it wanted entirely the bones of the feet.

The whole of this skeleton, however, is in excellent preservation; the bones are of a dark color, as the mastodon bones usually are, being impregnated with the oxide of iron, which no doubt has aided in their preservation. The tusks are perfect and short; a fact, which together with the aperture of the pelvis compared with its whole breadth, which is four feet ten inches, supports the opinion of its being a female. It had no tusk in the lower jaw, nor any vestige of their previous existence.

Accompanying this skeleton there were two perfect heads, and also two additional lower jaws, together with a number of teeth and other bones. By means of the teeth, which were contained in the jaws of animals of different ages, a complete dental series is displayed from an early period in the calf to its termination in the adult.

This valuable collection has been purchased by a number of gentlemen in Boston with the intention of presenting it to Harvard University. It has already been described by Dr. John C. Warren at a meeting of the American Academy of Arts and Sciences in November last; and we learn that this gentleman will hereafter publish a minute description of both the specimens, accompanied with figures designed to represent them with accuracy. Some interesting points of anatomy will, it is hoped, be elucidated by these descriptions, and particularly the question of the existence of the Tetracaulodon as a distinct species.

13. *Missouri and Mississippi Valleys*, (from the Report intended to illustrate a map of the hydrographical basin of the Upper Mississippi River, made by I. N. Nicollet, Feb. 16, 1841. Washington, 1843.)—This valuable report by the late Mr. Nicollet, describes one of the most remarkable countries of lakes in the world. The map illustrating it is full of interest to the geologist, and was the result of vast labor. Mr. Nicollet was well known for his extensive learning in science, his accuracy in observation, and his untiring zeal. The report gives a topographical account of the region to which it relates, with numerous geological and botanical observations. As some account of the cretaceous and other formations of the Missouri has already appeared in the Journal, we cite at this time a few remarks on the Mississippi and Missouri valleys.

"The basin of the Upper Mississippi is separated in a great part of its extent from that of the Missouri by an elevated plain; the appearance of which, seen from the valley of the St. Peter's, or that of the *Rivière Jacques, looming as it were a distant shore*, has suggested for it the name of *Coteau des Prairies*. Its more appropriate designation would be that of *plateau*, which means something more than is conveyed to the mind by the expression, *a plain*.

"Its northern extremity is in latitude 46°, extending to 43°; after which it loses its distinctive elevation above the surrounding plains, and passes into rolling prairies. Its length is about two hundred miles, and its general direction N. N. W. and S. S. E. Its northern termination (called *Tête du Coteau* in consequence of its peculiar configuration) is not more than fifteen to twenty miles across; its elevation above the level of the Big Stone lake is eight hundred and ninety feet, and above the ocean nineteen hundred and sixteen feet. Starting from this extremity, (that is, the head of the Coteau,) the surface of the plateau is undulating, forming many dividing ridges which separate the wa-

ters flowing into the St. Peter's and the Mississippi from those of the Missouri.

"Under the 44th degree of latitude, the breadth of the Coteau is about forty miles, and its mean elevation is here reduced to fourteen hundred and fifty feet above the sea. Within this space its two slopes are rather abrupt, crowned with verdure, and scolloped by deep ravines thickly shaded with bushes, forming the beds of rivulets that water the subjacent plains.

"The Coteau itself is isolated, in the midst of boundless and fertile prairies, extending to the west, to the north, and into the valley of the St. Peter's.

"The plain at its northern extremity is a most beautiful tract of land, diversified by hills, dales, woodland, and lakes; the latter abounding in fish. This region of country is probably the most elevated between the Gulf of Mexico and Hudson's Bay. From its summit, proceeding from its western to its eastern limits, grand views are afforded. At its eastern border particularly, the prospect is magnificent beyond description, extending over the immense green turf that forms the basin of the Red River of the north, the forest-capped summits of the *hauteurs des terres* that surround the sources of the Mississippi, the granitic valley of the Upper St. Peter's, and the depressions in which are Lake Travers and the Big Stone lake. There can be no doubt that in future times this region will be the summer resort of the wealthy of the land."

14. *Palæozoic deposits of Scandinavia;* (Quar. Jour. Geol. Soc., No. 4.)—The great extent of the crystalline rocks in Scandinavia, is described by Mr. MURCHISON, as one of its most remarkable features. They occupy the great part of Sweden, rising into mountains and forming the flanks of troughs, containing palæozoic strata, which have in their turn been invaded by granitic, porphyritic, and trappean rocks of another epoch. The lowest fossiliferous rocks are Silurian. Above them are shales and coral limestones, corresponding to the Wenlock limestone of England, and flagstones and schists, which probably represent the Ludlow rocks. Many instances of metamorphic changes are instanced by Mr. Murchison. A few miles north of Drammen, a limestone, containing the Pentamerus oblongus, is changed to marble, near granite, and some portions were thickly impregnated with garnets, or even changed to a garnet rock. On receding from the granite, the strata resume their natural characters, and Pentameri appear again. At Christiana, on the east side of the bay, the greenstones and porphyries have changed a fucoid shale to a rock closely resembling gneiss. The alteration is gradual, from the stratified schists to the highly contorted and metamorphosed masses. Forchhammer supposes that the fusion of the gneiss, which the change is believed to have required,

took place through the aid of the potash (as a flux) in the shale derived from the decomposition of the imbedded fucoids. Murchison reasons, from the vast abundance of fuci in the existing seas of those regions, that the view is a probable one.

Gneiss, or granitic gneiss, is stated by Murchison to be the fundamental rock of Sweden, existing with often high inclinations, before the lowest Silurian beds began to be formed. The facts also show that the crystalline ridge of the Omberg, must have been upheaved long after it was metamorphosed and rendered crystalline, inasmuch as the lower Silurian rocks upon the granitic, though highly dislocated, occur as soft shales and impure unaltered limestones and sandstones. The upper Silurian rocks are almost wholly absent from the main land of Sweden, showing that the former country had been uplifted before their deposition, and the same exist exclusively in Gothland.

"When viewing the great features of the earth," says Mr. Murchison, "the geologist who compares the northern frontier of palæozoic deposits of Scandinavia and Russia with that of British North America, recently described by Captain Bayfield, cannot avoid being struck with the great similarity of succession in these two vast regions. In both, the general range of the rocks is from S. W. to N. E.; in both, the same type of lower Silurian deposits occurs, and rests upon more ancient crystalline rocks; and in both, are these strata succeeded in similar ascending order, by upper Silurian, Devonian, and Carboniferous deposits. We may still further pursue the analogy by stating that in both regions, great sheets of water range more or less along the older frontier line, and lastly, that in both, large quantities of erratic blocks have been transported from N. to S., or from N. N. W. to S. S. E."

"I will conclude this memoir by stating as one result of the examination of the fossils of Scandinavia, that as the lowest fossiliferous rocks of that tract are unequivocally of the same age as the lower Silurian rocks of Great Britain and America, so the deposits which occupy the governments of St. Petersburgh and Reval are the same as those of the continent of Sweden; in the latter country (I speak now of its central mass) no upper Silurian having yet been discovered.

"In both countries it would appear, (the central mass of Sweden only being alluded to,) that this group, proved to be protozoic by its having been deposited on antecedent crystalline and azoic rocks, is uncovered by upper Silurian, though the latter deposit is copiously and unequivocally exhibited in the great island of Gothland on the Swedish side, and in the smaller isles of Dago and Oesel, near the Russian shores. Thus it would seem that immediately after the completion of the lower Silurian group, these two continents were elevated and placed beyond the reach of the depositary influence of the sea in which the isles were

formed, and therefore that in ancient times, as at the present day, a great trough existed between these opposite continental masses of land. This early elevation was probably unaccompanied by any great fractures; for the lower Silurian rocks of both lands have still preserved a general horizontality, which is the more remarkable in the case of Russia, as it has been shown that the sediments, after having been raised, must again have been depressed to permit of copious marine accumulations of Devonian age upon their surface. In like manner, we must believe from the evidences of conformable apposition of the Devonian and carboniferous deposits of Russia, that no sort of disturbing influence could have existed in these regions when the one formation succeeded to the other. The uppermost beds of the Devonian, loaded with *Holoptychius* and *Onchus*, *Coccosteus*, *Placosteus*, and *Dendrodus*, are at once conformably surmounted by strata containing the most universally diffused carboniferous types. In short, fishes identical with those of the Old Red Sandstone of Scotland, are invariably surmounted by the *Stigmaria ficoides* and the large Producti of our British mountain limestone; and thus the examination of Russia has taught us, not only in this instance, but also in the overlying Permian succession, that the great changes in animal life have not been dependent on physical revolutions of the surface, but are distinct creations, independent of any such proximate local causes; though I would by no means deny that the grand operations of change which have affected the conterminous regions of Russia did not tend to produce these results.

"The first elevation and depression of the lower Silurian strata having been moderate, and probably not extensive, and those strata having, during the long succeeding Devonian and carboniferous periods, remained beneath the sea, in which these sediments were accumulated, we next reach that period of disturbance which is so strongly marked in nearly every part of Europe, or that which followed the close of the carboniferous epoch. Then it was that the whole of the older palæozoic series of Northern Russia was raised up in lines extending from S. W. to N. E. And, although even then their elevation must have been infinitely more equable than any of those upheavals which have determined the strike and escarpments of rocks of the same age in Western Europe, we cannot imagine the upward movement of such enormous masses from beneath the sea to some height above it, without the accompaniment of some of those transverse fissures and breaks, which, though feeble in the slightly elevated tracks, increase in intensity, with the amount of upheaval."

15. *Lines of Ancient Level of the Sea in Finmark;* by M. A. Bravais, (extracted from the Quart. Jour. Geol. Soc., No. 4, 1845, p. 534.)—M. Bravais has ascertained two distinct lines of elevation around the

coast of Finland or North Norway: one 221·4 feet in height at the southern part of the Alten fjord, gradually diminishes to 92·3 feet near Hammerfest; the other is 91·3 feet at the former place, and 46 feet at the latter. He also detects some evidence of two other lines; one between the two just mentioned, and the second below the lower one; the evidence however he considers doubtful.

16. *Supposed Birds' Bones of the Wealden.*—(To the Editors of the American Journal of Science.)—GENTLEMEN: Will you oblige me by the insertion of the following remarks in an early number of your Journal, that the error to which they refer may be noticed as widely as possible. The evidence on which the presence of birds in the country of the Iguanodon was inferred, is fully stated in the "Medals of Creation," vol. ii, p. 806, and an accurate figure is given of a fragment of bone which was supposed to be the tarso-metatarsal of a wader, on the authority of a rigid comparison by Prof. Owen. That eminent zoologist having lately re-examined the specimen, now finds that he was mistaken in his former interpretation of its character, and concludes that it is the lower part of the humerus, of which the upper part is figured in my memoir on the fossil birds of the Wealden, Geol. Trans., vol. v: an opinion in which I entirely concur. In fact, I found the two pieces of bone near each other, and though the intervening portions both of bone and stone were wanting, the resemblance was such that I attached the bones to a card, and by a dotted outline indicated their connexion; but Prof. Owen thought I was mistaken, and I yielded to his authority. Prof. Owen, in a paper read a few days since to the Geological Society, refers this humerus to a Pterodactyle, and expresses his conviction that all the supposed birds' bones belong to Pterodactyles; but to this sweeping conclusion I cannot assent. The articulating surfaces of the humerus are very imperfect, and we have no certain clue to the original form of either the upper or lower articulation; it is therefore impossible to determine with precision as to the resemblance between this bone and the corresponding one of a bird or of a flying reptile. Baron Cuvier from other bones in my possession, expressed his belief in 1830, that the existence of the fossil remains of birds in these deposits was unquestionable. In the present state of our knowledge it appears to me, that, although it is *probable* that the bones in question will prove to be Pterodactylian, the evidence is not *conclusive;* some of them may be referred to birds—and this long mooted point remains therefore in the state it was when I first announced the discovery of bones belonging to animals capable of flight, in the strata of Tilgate Forest. In the language of the illustrious Cuvier, "*le temps confirmera ou infirmera cette idée.*" The jaws with teeth, and several bones of a Pterodactyle, have lately been found in the chalk of

Kent, and are in the collection of Mr. Bowerbank: it is possible that the large bones discovered in the same quarry, and referred to birds, may also belong to flying reptiles. This subject cannot fail to interest your geologists. When the interpretation of apparently indisputable characters by such high authority proves to be erroneous, it should inculcate the necessity of the utmost caution in our explanation of phenomena which must be regarded as far more equivocal. Should all the *Ornitholites* of our secondary strata be put to flight by some new discovery, your *Ornithichnites* will, I fear, be in jeopardy.

I am, gentlemen, your respectful servant,

GIDEON ALGERNON MANTELL.

Chester Square, Pimlico, London, December, 1845.

17. *Bones of the Iguanodon and other colossal reptiles recently found in the Isle of Wight, England.*—Brook Point in the Isle of Wight, must be known to our readers as a celebrated locality of the fluviatile deposits called Wealden, being described both in "The Wonders of Geology" and in "The Medals of Creation," by Dr. Mantell. A recent examination of this spot has led to some highly interesting discoveries, which have formed the subject of a communication lately laid by Dr. Mantell before the Geological Society of London, and which we trust will be published at length in the Transactions of that learned body. The occurrence of fossil trees along the strand at Brook Point, was first observed by the late Mr. Webster; and it is well known that water-worn fossil bones of reptiles have often been collected along the coast. The large fossil fresh-water muscle shells (*Unio valdensis*) described by Dr. M. in a former number of this Journal, are from the same place. The fossil trees that occur at Brook Point are imbedded in a sandy argillaceous rock, which forms the lowermost strata of the cliff: the stems and trunks visible beneath the sea weeds at low water, have been exposed in consequence of the removal of the deposit in which they were imbedded, by the action of the waves. The *bark* of these trees is in the state of lignite; the woody fibre is calcareous and permeated with veins of pyrites; coniferous structure is visible under the microscrope. With the trees are found bones of the Iguanodon, Cetiosaurus, Streptospondylus, Megalosaurus, and other colossal reptiles, and the Uniones above alluded to. From various data specified in the memoir, Dr. Mantell conceives that this collocation has taken place in consequence of the trees having originally formed a "raft," like those of our Mississippi, which drifted down the river of the country of the Iguanodon, entangling in its course the limbs of reptiles floating in the water, and the muscle shells in the sand or silt of the delta. Among the specimens recently collected by Dr. M., are the thigh-bone of an Iguanodon three feet four

inches long, and a portion of a tibia or leg-bone, which when perfect must have been between four and five feet long.

18. *Notice of what appears to be the Embryo of an Ichthyosaurus in the Pelvic cavity of Ichthyosaurus* (*communis ?*) by J. CHANING PEARCE, (Ann. Mag. Nat. Hist., vol. xvii, pp. 44, 45, 46.)—In developing an *ichthyosaurus* which I took up from the rock in the brown laminated lias clay of Somersetshire, and having reversed the animal so as to lay bare that surface which was downwards in the quarry, I removed the clay with great care and exposed to view an *Ichthyosaurus communis ?* about eight and a half feet long, lying on its back in the highest state of preservation, and with the exception of a slight dislocation in the middle of the tail and the deficiency of its point, every part is most perfectly preserved. In cautiously lifting the laminæ of clay between the two hinder paddles, my attention was first arrested by a series of small vertebræ lying on three or four of the posterior ribs; on removing another portion of the clay, ribs, the rami of the jaw, and the other parts of the head were visible. In carefully cleaning this delicate little skeleton, it was found to rest on black, finely corrugated integument, which is preserved around the small skeleton, and passes underneath the posterior ribs and some other parts of the large animal.

The little animal, somewhat dislocated, lies at full length in the cavity of the pelvis, with its head towards the tail of the large one, and rests on the internal surface of its integument, and on the internal surfaces of three of its posterior left ribs, and is about five and a half inches long. The rami of the jaw and one of the longest ribs (of which only five or six are discernible) are each about an inch long; and of the thirty vertebræ which can be counted, the largest is the eighth of an inch in its longest diameter. It is bounded on either side by the ilium, ischium and pubis, and by the right and left posterior paddles, and on the right side by the vertebral column and right ribs; and while the posterior two-thirds of the little animal is within the pelvis, the head appears to protrude beyond it, and apparently in the act of being expelled at the time of death.

So singular a circumstance as an embryo being found in the pelvis of its parent in a fossil state, should lead to the greatest care in arriving at such a conclusion; but when we consider that the large animal was developed on its under surface—consequently it is nothing that has fallen upon it—and the remarkably correct position of the little skeleton in the pelvis, between the right and left ribs, with its head protruding, and the little vertebræ so exactly corresponding in shape to the large ones, and the other bones resembling those of a saurian, it appears fair to conclude that it cannot be anything else but a fœtal ichthyosaurus; and if it be suggested that it may have been swallowed by

the animal, this involves a much greater difficulty; for so delicate a structure would have been dissolved by the gastric juice, and could not have reached its present position.

The Rev. Dr. Buckland and Prof. Owen, who have kindly written me on the subject, state, that there is no reason why the ichthyosaurus should not be viviparous, although "analogy of the nearest existing reptiles would point to its oviparity as the more probable kind of generation; but the genus Zootoca and the Viper show that analogy is no safe guide in such a question;" "and the European black and yellow salamander of Bohemia once brought forth young ones half as long as the mother, either in the doctor's pocket or college rooms;" therefore with such evidence it now appears fair to conclude that the Ichthyosauri were viviparous.

19. *Grooves or Scratches in North Wales;* by A. F. Macintosh, (Quart. Jour. Geol. Soc., No. 4, 1845, p. 460.)—Mr. Macintosh, after describing many instances of the fluting or striations of rocks in North Wales, proceeds to show that they cannot be explained by the hypothesis of icebergs, and must be attributed to peculiarity of structure in the rocks. In a case near Bedd Gelert, he remarks that the flutings are more regular, more accurately parallel and more symmetrically placed, than could be the case had they been produced by the passage of a glacier. There is scarcely any variation in depth or direction, and however numerous the lines, they are uniformly and strictly parallel. Phenomena of such a kind he concludes must be *structural.* Similar evidence in other regions is appealed to in support of this conclusion. Certain low rounded rocks in the valley of Llugwy are regularly furrowed in continuous parallel lines, not only from top to bottom, but on the sides accessible to view. Certain conglomerates have broader and wider flutings than the schists; and moreover, fragments of schist in these conglomerates have fine flutings wholly independent of the rock containing the fragments. Mr. Macintosh maintains farther that there is a connection between the flutings and the cleavage, the former being parallel with the latter. He suggests that the striated and furrowed rocks in the United States, attributed by Prof. Hitchcock to glacial action or ice, may be of structural origin.

20. *Phosphorite Rock of Estremadura, Spain, a good material for manure,* (Rep. Brit. Assoc. for 1844, p. 28.)—Prof. Daubeny states that this rock forms a solitary mass, penetrating clay-slate, the dimensions being at most fourteen feet in width, its length along the surface of the ground extending to about two miles. The composition is about 80 per cent. of triphosphate of lime and about 14 fluoride of calcium; and he suggests as a final cause of the secretion of so large a mass of both these substances in the older rocks, their being intended to supply

two necessary ingredients for bones and other animal matters. Such a rock, he observes, can hardly fail to be useful as a manure, if found in an accessible locality; and it would be worth the while for geologists to search for veins of this mineral in the older formations of this and other countries.

21. *Fresh-water Formation of the Smyrna Harbor*, (Quart. Jour. Geol. Soc., No. 2, p. 162.)—From the examination of fossils, Mr. E. Forbes has ascertained that the great fresh-water formation which skirts the Gulf of Smyrna and the coasts of many islands in the neighboring portion of the Archipelago, is of the age of the Paris basin and London clay. Whether the fresh-water tertiary basins of the interior of Asia Minor, and of the valley of the Xanthus, and the islands of Cos and Rhodes, are of the same age or not, remains still doubtful; though from the numerous fossils examined, Mr. Forbes is inclined to pronounce them of a later origin, yet anterior to the pliocene marine formations of Asia Minor and the Sporades. Of the fossils from Smyrna, one is the Limneus longiscatus of the Paris basin, and another apparently the L. ventricosus, also a Paris basin shell. Three species of Planorbis also are closely allied to, if not identical with, Paris basin fossils.

22. *Geology of New South Wales, New Holland and Van Dieman's Land*, (Strzelecki's New South Wales.)—The stratified rocks of New South Wales and New Holland, from the mica slate upward reach only to the variegated sandstone, which rock rests on the coal deposits. The whole thickness does not exceed 2200 feet, of which 1400 feet consist of sandstone alone. The crystalline and sedimentary rocks of New South Wales bear to one another the proportion of 3 to 1, and the former include granite, protogen, quartz rock, syenite, eurite, porphyry, greenstone and basalt. The coal of New Holland is bituminous and constitutes a series of beds 2 to 5 feet thick, alternating with sandstone and a soft clayey shale. The principal deposits are those of the Hunter River valley, which is worked at New Castle at the mouth of the river, and that of the district of Illawarra. Numerous fossil plants are found with the coal, among which the Glossopteris Browniana is by far the most prevalent form. Below the coal lie deposits of sandstone and limestones, which often abound in fossils.

23. *Salt Lakes and Coal Beds of Cape Breton;* from an account of its geology by Richard Brown, Esq., (Quart. Jour. Geol. Soc., No. 2, 1845, p. 207.)—The island of Cape Breton is separated from Nova Scotia by the Gut of Canso, and is about 120 miles long from north to south, and 90 miles wide. A line of highlands commencing at Cape North continues 60 miles to St. Ann's on the east shore, and as far to Margarie on the west shore, presenting with few exceptions bold cliffs

to the ocean. These highlands constitute a table land 15 to 20 miles broad, and 600 to 1000 feet high, in most places incapable of cultivation. Through the rest of the circuit the shore is mostly loose and undulating, or bordered by a bluff of 20 to 100 feet. In the very heart of the island there are two large salt-water lakes, each communicating with the sea, and one by a channel navigable for ships of the largest class. The Grand Cam is 40 miles in length and 20 in width. The scenery of the lakes is exceedingly striking, the conglomerates constituting long ranges of undulating blue hills, rising behind one another in the distance; whilst the white cliffs of gypsum stand out in bold relief on the margin of the water. Some idea of the extent of these lakes may be formed from the fact that there is no point in the island more than 12 miles distant from salt water. The shores of the lakes are thickly studded with the cottages of thriving settlers, and a narrow belt of cultivated land stretches along the water's edge.

The coal formation furnishes Newfoundland, Nova Scotia, and Prince Edward's Island with an abundant supply of coal, equal in quality to the best Newcastle. The coal field of Sydney on the north-east coast of the island, averages about 7 miles in width, and covers an area of 250 square miles; and this area is probably only the segment of an immense basin extending towards the coast of Newfoundland. The larger beds range from 4 to 7 feet in thickness, and besides, there are others of 2 feet. They rest on clay floors containing remains of Stigmaria. Trunks of trees, both vertical and inclined, are occasionally found; and also fishes' scales, teeth, fins and bones and coprolites. Along with the carboniferous limestone are extensive beds of gypsum and marls, and in the gypsum districts salt springs are not uncommon.

Granites, syenite and porphyries occupy a large part of Cape Breton, and the high table land is supposed to consist wholly of primary rocks.

24. *On the Palæontology of South America.*—M. Alcide D'Orbigny, the distinguished South American traveller, arrives at the following general conclusions in his work on South America,—chap. xii.

There is a general correspondence in the fauna of the successive formations of Europe and South America; and the earlier were in general the more simple forms of life.

No transitions between specific forms can be detected in rocks; living beings succeeded one another not by gradual transitions, but by the extinction of races and their replacement.

There are some identical species of fossils between the distant continents, proving the cotemporaneity of the rocks.

The uniformity of the fauna of the earlier periods, must be attributed in part to a uniform temperature, arising from central heat. This uni-

formity continues even to the era of the lower cretaceous deposits, when it began to be lost by the cooling of the earth; the limits to regions presenting the same conditions as regards heat and other circumstances, were thus contracted, and the fauna became diversified, being broken up into areas or basins of small extent. The cause of the strong line of division between the several formations, as indicated by the fauna, was some general catastrophe. The extinctions, more or less perfect, of races of fossils, were due to dislocations or disturbances of the earth's surface. The elevation of the Andes was one of these catastrophes.

Previous to the cretaceous formation, the heat of the earth proceeding from the central heat, was such as to render null all the influence of latitude in producing cold; and only subsequent to this period, has the last mentioned effect operated in localizing organic beings on the earth.

25. M. Agassiz *on the Geological Development of Animal Life*, (Ann. Mag. Nat. Hist., xvi, 355, from Jahrbuch für Mineralog. Geolog., &c., Part 3, 1845.)—The Zoophytes, Mollusca, and Articulata existed in the earliest period of the earth's development, although all their classes were not numerously represented in the oldest members; but they do not allow of our supposing that any progressive perfection to the present creation occurred. This is the case with the Vertebrata only, among which fish appeared in the first period, reptiles in the second; mammalia and birds did not appear for a long time after the former; lastly came man, as lord of all: hence M. Agassiz denominates the corresponding periods, those of fish, reptiles and mammalia.

The greatest change in the fish occurred at the end of the Jura period. All fish which existed prior to the chalk have a peculiar aspect and belong in general to extinct families; those of the latter epochs resemble those now living, and many of them belong to families and genera at present in existence; but they all differ specifically, just as *all* Vertebrata in different geological epochs differ in species.

26. *Fossil Shark*, (*Hybodus.*)—(Quart. Jour. Geol. Soc., 1845, No. 2, 197—with a plate.)—The entire mouth of a shark, partly open, has been found by B. Ibbetson in the Isle of Wight. The upper jaw measured ten inches, and appeared to have carried twenty four teeth in the front series. The discovery decides a doubted point, that the teeth of the two jaws are similar in form. The Genus Hybodus attains its maximum expansion in the oolite, but ranges from the muschelkalk to the chalk inclusive.

27. *Lower Green-sand Fossils.*—A catalogue of the fossils of the lower green-sand in the museum of the Geological Society, is given in the London Quart. Jour. Geol. Soc., No. 2, 1845, pp. 237–250. Some new species are described from the museum and other collections.

## III. Zoology.

1. *On the Formation of Cells;* by M. Coste, (Ann. Mag. Nat. Hist., xvi, 377, from Comptes Rendus, Oct. 20, 1845.)—The prevalent view with regard to the formation of cells, is a generalization of Purkinje's theory upon the development of the egg in the ovary. Its fundamental character consists in the supposed existence of four successive periods or phases in their development.

The *first* is represented by the appearance of the nucleolus, which is the basis of the structure, and itself results from a simple agglomeration of the molecules of the cytoblastema.

The *second* corresponds to the deposit and to the coagulation of the cytoblast or nucleus around the nucleolus, considered as the unique and exclusive centre of all cell-formation.

The *third*, to the deposition and coagulation of the cell-wall around the cytoblast, which it grasps at one point of its substance, and on one side of which it appears at first applied like a watch-glass upon its frame.

The *fourth* is expressed by the absorption of the nucleus and by the admission of cellular contents, which, being subsequently introduced, cannot consequently have taken any part in the formation of the parietal membrane.

Now if this is the sole mechanism by means of which all organic cells are developed,—if it be true that the four fundamental modifications which prepare the way for their walls are always produced in the order of succession which we have pointed out, it should result that wherever there are cells in the course of formation,—the cytoblastema should present in the metamorphoses of its substance, each of the material modifications which constitute the terms of this essential succession. If then the theory is to aspire to the rank of a general doctrine, it will be necessary that in the self-organizing mucus we should always be able to meet with the free nucleolus, the nucleolus enclosed by the cytoblast, the cytoblast at the moment at which the cell-wall is deposited on its periphery; and finally the cytoblast, enclosed in the thickness of the parietal membrane, disappearing in proportion as the cell contents are introduced into the cavity of the latter.

But when we search for the facts upon which so radically exclusive a theory is founded, we experience the twofold astonishment of not meeting, in those authors who originated it, with a single example, the value of which we cannot seriously contest, and of not finding in nature those abundant proofs which cause a system to prevail, or at least allow the formula to remain, as the most faithful expression of the most numerous category. Thus, in examining the proofs cited by Schwann

in support of this hypothesis, we find that they may be reduced, as M. Vogt has remarked, to a single observation directly made on cartilage; and yet this observation, presented by Schwann himself as very doubtful, has been shown to be false by the researches of M. Vogt on the cartilage of the accoucheur-toad. In fact, in a very large number of cases, the nucleolus to which the theory attributes the exclusive privilege of causing the amorphous matter to produce the cell-walls—in a very large number of cases, I say, the nucleolus never appears free and isolated in the midst of the cytoblastema. On the contrary, we always find that this corpuscle, even from the first commencement of its appearance, is still enclosed in the cavity of the cell, which is previously formed, frequent instances of which we find in the tissues of the embryo of osseous fishes; it is evident that in these cases at least the nucleolus has taken no part in the formation of the cell, as it was not in existence when the latter was produced. In other cases, this corpuscle did not appear at any period of the existence of the cells, and consequently we should have no motive for making it intervene as a determining cause, since it does not leave to the theory even the pretext of co-existence. This may be easily verified by studying the development of the large cells which form the internal expansion of the umbilical vesicle of serpents.

Hence the tardy appearance of the nucleolus in certain cases, and its total absence in others, form a serious impediment to the theory which locates the exclusive determining cause of all cell-formation in the pre-existence of this corpuscle. This also shakes the very foundations of the doctrine, and tends at the least to restrain its application.

As regards the cytoblast or nucleus, M. Vogt has already shown that it has no influence on the formation of the cell-walls of the embryo of the osseous fishes; I have been enabled to convince myself that the large diaphanous vesicles in the spinal cord of the Batrachia do not appear until after the production of the parietal membrane of these vesicles.

But because the intervention of the nucleolus is not always necessary for the formation of the cells, and because the cytoblast or the nucleus does not itself, in a certain number of cases, retain the function assigned to it by theory, must we necessarily conclude that the cells are never developed around a centre upon which the forming walls would mould themselves? Undoubtedly we shall have frequent opportunities of observing limited masses of matter becoming coated with an envelope, and thus constituting the contents of the pouch which is formed at their periphery; but we shall then remark, that in most of these cases this happens in a very different manner from what the theory supposes; for the matter which has constituted the centre, instead of being absorbed by the parietal membrane, to make room for the cellular contents sub-

sequently introduced, itself forms the cellular contents, fills the cavity of the new cell, may there be applied to different prolonged functions, may live longer than the cell itself, or remain in reserve in the cavity of the latter, to serve the further purposes of nutrition or generation of new cells. The egg, in the two united vesicles of which it is composed, presents us with striking examples of a survival of the matter which has served as a generating centre, because we there see the germinative corpuscles persist when the parietal membrane which encloses them is dissolved, and take part in the new formations after it has been completely absorbed. The yolk there survives the vitelline membrane, and whilst the latter is gradually destroyed from the earliest period of its development, we see the yolk continue to nourish the embryo until after its birth.

Such are the grave, numerous and decisive objections, which arise against a doctrine, which must rather be considered as a bold invention of the mind than the carefully considered expression of satisfactory observation; but although the bases of this doctrine are uncertain, it has not the less rendered an eminent service to science, because in the commencement it gave rise *à priori* to the conception of the possibility that cells might be developed around a centre; and its influence has been very great in directing observers in a fruitful path, and in exciting important researches, among which we may mention those of Valentin, Vogt, Bergmann, Reichert, Bischoff, Barry, Lebert and Henle. In my turn I shall make known the result of the observations which I have made upon so disputed a subject—observations which during several years have been many times detailed in the course of instruction which I give in the College of France.

2. *Microscopic Structure of Shells.*—An elaborate article on the microscopic structure of shells, by W. Carpenter, opens the volume of Reports of the British Association for 1844. It is illustrated by twenty plates, containing enlarged views of sections of various species of shells. The various facts ascertained are considered as proving that the calcerous matter is secreted within animal cellules, and owes its peculiar structure to this mode of formation. Many shells broken across have what appears to be a crystalline fibrous structure. This is eminently the case with the Pinna. But Mr. Carpenter shows that each minute prism is encased in animal membrane within which it was secreted; and by solution in acid, he obtained the animal portion having the same basaltiform character as the shell. In a transverse view magnified, the surface appears finely tesselated with polygonal areas, which with a power of 10 diameters are about a third of a line broad. This prismatic structure, when present at all in shells, forms the *external* portion, and is considered by Carpenter as corresponding to a *calcified epithelium*,

It thus corresponds with the enamel of teeth, to which it is analogous in every respect, save the character of the mineral secretion and the larger size of the prisms.

The inner portion of shells (and the whole of many) is described as destitute of the distinct prismatic structure, and no trace of cells can, for the most part, be distinguished. This is designated the *membranous* shell structure, and instead of corresponding to epithelium or epidermic secretions, like the prismatic portion, it is believed to proceed from the *true skin* below the epidermis. Mr. Carpenter considers the secretion as having been formed within cellules, but that these cellules disappeared by bursting or liquefying; a few only of these cellules remain entire which appear scattered through the layer.*

* On polishing down the lamellæ of some *Astræa corals*, and examining with a microscope, nearly the same structure may be observed, as here described by Mr. Carpenter. There are no certain indications of regular cellules, even when magnified 300 diameters, and only a minutely clouded appearance is made out, too indefinite in character to be represented. By rubbing a crayon over a piece of paper a little rough, as good a figure of it would be had, as a more labored sketch could give. There were parallel bands of light and shade corresponding in direction with the margin of the plate, and with all its dentations, which indicated what other observations had shown, that these plates gradually enlarge by the extension of the edge; and this was the only evidence made out of regularity of structure. Examined with a polarizing attachment to the microscope, the thin slices permitted the polarized light to pass, but no colors were exhibited, except in points which were extremely minute when magnified 150 diameters, the power used in making the observation. This fact indicated that the coral plates were composed of minute granules, confusedly aggregated, as if each had been the result of independent formation, or the secretion of a separate animal cellule. There was no reason whatever to infer that the particles of the plate had been secreted, and accumulated by superposition, under crystallogenic forces; on the contrary the structure was completely amorphous, and such as could have resulted only from a mere aggregation of extremely minute granules, themselves crystalline. These lamellæ, it is well known, are *internal* secretions, as *also is the whole coral.*

The structure of the spicula in the Alcyonia appears to be somewhat different. These spicula are commonly five or six times as long as their greatest breadth, and are more or less pointed at each extremity. The surface is usually rough with minute prominences. When polished down very thin, faint lines varying in distinctness are seen to run parallel with the edge, through all its uneven outline; that is, there is evidence of a concentric structure, evincing that the spicula are formed by successive superpositions over the irregular surface. The concentric layers in the transsected knobs, have their edges towards the observer, and consequently they are not as transparent as the flat parts between. In polarized light the spicula exhibit brilliant colors; and the same magnifying power which gave scarcely visible points of color with the lamellæ of the Astræa, here afforded sheets half an inch or more in breadth, of rich green and flame tints. The spicula appeared therefore to be the result of a simple crystalline superposition of the calcareous material from the depositing secretions. With a power magnifying 300 diameters, no trace of animal cellules was distinguished, and no regular texture apart from the evidences of a concentric structure above stated. J. D. D.

The *nacreous* or *mother of pearl structure* has been supposed to be due to the cropping out of laminæ in succession. But Mr. Carpenter finds that the iridescence is exhibited by the animal membrane after the calcareous matter is removed, and moreover that it belongs to a *single* layer of membrane, and is owing to a corrugation of the surface or a series of folds or plaits, which lie more or less obliquely to the general surface.

Mr. Carpenter pursues the subject with great minuteness and skill, and ascertains characters from his investigations for determining the affiliation of groups. Characters also are afforded for distinguishing in many instances even species, and these characters it will be observed, are obtained from mere fragments.

3. *On Belemnites*, (Quarterly Journal of Geology, No. 1, p. 119.)—The Belemnite, whose connection with the Cephalopoda, or the cuttle-fish tribe, has been for some years determined, is regarded by Richard Owen, Esq., as forming a transition link between the two genera Sepia and Spirula, though uniting also some of the characters of the genera Sepiola and Onychoteutis. "The lateral fins of the Sepia are narrow, and extend from the apex of the mantle to near its base, while the fins of the Belemnite were relatively shorter and broader, and situated a little in advance of the middle of the body. In the relative size, shape and position of the fins, the Belemnite must have most nearly resembled the species of the existing Rossia and Sepiola; but it differed in the more elongated and slender body." "The Belemnite, with the advantage of its dart-shaped and well balanced shell, must have enjoyed the power of swimming backwards and forwards by the action of its cephalic and pallial fins, with greater vigor and precision than the modern Decapod Dibranchiata. The position of the animal was probably more habitually vertical than that of its recent congeners. Thus placed, the Belemnite, in quest of prey, would rise swiftly or stealthily to fix its claws in the belly of a supernatant fish, and then dart down to drag its prey to the bottom and drown it. And we cannot doubt that the ancient Belemnites were in their day the most formidable and predaceous of Cephalopods."

4. *Trilobites*, (ibid., p. 132.)—Burmeister, in a late treatise on Trilobites, places these fossil Crustacea among the Entomostraca, and near the genera Apus and Branchipus. Dr. Burmeister, as has been done by other naturalists, suggests that the fossils are often only the fossilized exuviæ, as these animals must have cast their exuviæ like other Crustacea. The so called genera *Battus* and *Agnostus*, he considers as *young* individuals of different species, in which state Crustacea often differ very widely from their adult forms. Dr. Burmeister concludes that they swam with the back undermost, and lived near coasts or in shallow waters.

5. *Fossil vertebræ of Shark*, (Trans. Roy. Soc., Edinb., xv, 643.)—The vertebræ of most cartilaginous fishes have been shown to have a bony nucleus or framework, and many do actually occur in the fossil state.

6. *General views on the Classification of Animals;* by J. D. DANA, (Proceed. Acad. Nat. Sci. Philad., ii, p. 281, Oct. 1845.)—In Cuvier's classification of animals, the division Radiata includes all invertebrated animals not comprised in either of the sub-kingdoms, Articulata and Mollusca. Consisting thus only of refuse species, and not limited by positive characters, as Owen states, we should not expect that the group could be a *natural* assemblage. No line of subdivision, however, has yet been made out, which has met with general favor; yet greater precision has been given to our views of the affinities that run through the animal kingdom, by appealing to the nerves, the seat of sensibility and sentiment, as a basis in classification; and in this manner the subdivisions have been characterized as follows by Dr. Grant.

I. The *Vertebrata*, having a brain and a spinal cord, constitute the SPINI-VERTEBRATA. II. The *Mollusca*, having the nerves forming generally a transverse series of ganglia disposed around the œsophagus, the CYCLO-GANGLIATA. III. The *Articulata*, having no proper brain, and the main cord which runs the length of the body, double, the DIPLO-NEURA. IV. The *Radiata*, having a radiate structure in the body, and the nervous ganglia arranged in a circle, CYCLO-NEURA.

An objection might be made to this system, on the ground of the apparent absence of nerves in some of the lower orders. But a real absence can hardly be concluded from our inability to distinguish them. Many of these animals show by their voluntary motions and sensibility that nervous influences traverse the body: moreover, nervous matter is secreted in lines. We can therefore only infer the indistinctness, and not the absence of nerves from our ineffectual efforts to trace them out; and we must consequently be guided by general structure, in determining the relations of groups, when the nerves fail of giving aid.

The above arrangement fails, in some respects, of presenting a clear idea of the system in nature, although highly philosophical in its general features. A study of the animal kingdom, as has been lately shown, brings to light lines or general systems of development branching up from the lowest Infusoria to the higher grades of life. It is not true that the forms among the *lower* grades are actually copied in any of the imperfectly developed young of the *superior;* yet there is some general analogy, sufficient to indicate that the former commence on the same system of development with some of the latter, although carried essentially out of the direct upward line by the peculiar vital forces of the species. The Rotifera are decidedly crustacean in type. Their stout mandibles are precisely those of the Cyclopacea in position, and

also in general form; and in their mode of reproduction, the animals are closely similar; yet no young crustacean is ever a Rotifer. The latter belongs to the same system of development with the former, but is a distinct branch, from the regular line, characterized by the peculiar natatory organs, which appear to be the analogues of the branchial or basal appendages to the feet in Crustacea. The same reasoning applies to the Bryozoa or Flustroid polyps, which are as nearly allied to the Tunicata as the Rotifers to Crustacea.* It is a side-development from the imaginary line, which connects the Infusoria with the tunicated molluscs. The Entozoa afford other examples, one branch of them passing into the Crustacea through the Lernæidæ and Caligidæ, and another into the Annelida.

These remarks are intended to support no monad or Lamarckian theory, but only to elucidate the established principle that there are in nature certain distinct systems or types of development. Each species is developed with some reference to one or the other of these systems, but, through the agency of the vital forces peculiar to itself—forces which there is reason to believe only creative power can change.

In accordance with these principles, the several orders of animals may be arranged as follows:

I. Vertebrata.

| III. Articulata. | | II. Mollusca. |
|---|---|---|
| Insecta, Myriapoda, Arachnida, Crustacea, Annelida. | IV. Radiata. Echinodermata, Zoophyta, Acalephæ. | Cephalopoda, Pteropoda, Gastropoda, Conchifera, Tunicata. |
| Rotifera, Entozoa. | | Bryozoa. |

V. Protozoa or Infusoria.

A radiated structure characterizes in general the simplest forms of animal life. Passing up from the monad globule, this structure has its highest development in the Echinoderms. Among Zoophytes, the Hydra forms the first step upward, in which the digestive cavity is a mere sac, which will work equally well inside out, and the mode of reproduction is extremely simple. From this group we pass to the Actinia, in which there is a distinct stomach and a series of fleshy lamellæ around the internal cavity—the first rudiments of an insolation of the

* The Bryozoa have been placed near the Rotifera; but the absence of mandibles, as well as their peculiar type of structure, separates them widely from these Crustaceoid species, and allies them as closely to the Tunicata, with which they were first associated by Thomson, under the name of Polyzoa. Lister has a finely illustrated article on this subject in the Philosophical Transactions for 1834, p. 365.

functions of digestion and generation—but the circulating fluid is only the elaborated chyle mingled with more or less water from without. A step farther and we find separate organs for the functions of the liver, and a circulating system, in some Echinoderms. Through the Bryozoa, the Infusoria are connected with the Tunicata and the other Molluscs; and through the Rotifera and Entozoa, they connect with the Articulata, thus passing by each way, out of the true Radiate type, into that which characterizes the higher sub-kingdoms. The Bryozoa, Rotifera, and Entozoa, may be arranged in the sub-kingdom Radiata, or with the Mollusca and Articulata, whose types of structure they exhibit, though under a Radiate form.

The Echinoderms, although so strikingly peculiar in some species—the Echini—yet through the Holothuria, bear closely upon the Articulata; while the Acalephs incline toward the Mollusca.

In the above remarks, it is not attempted to trace out all the gradations in the groups referred to, but only the most prominent. The animal kingdom is throughout a network of affiliations, yet there are main trunks and larger branches, to which the smaller anastomosing ramifications are subordinate. Much study will be required before the system of nature from the Protozoa up, can be correctly mapped out.

### 7. *Zoological Researches.*

*Annals and Magazine of Natural History, for November*, 1845.—On new Lepidoptera, by E. Doubleday, (continued.) Notice of a new genus of Nudibranchiate Molluscs, by J. Alder and A. Hancock.—G. R. Waterhouse, on some new Heteromerous Coleoptera.—L. Pfeiffer, descriptions of new land shells from Cuming's collections. *For December.*—On the Spongiadæ, with descriptions of some new genera, by J. S. Bowerbank; illustrated by two plates.—Descriptions of three species of Mus, one of Hapalotis and one of Podabrus, from Australia, by Mr. Gould. *For January.*—Descriptions of species of the genera of insects Phyllobius, Polydrosus and Metallites, by J. Walton.—New species of Spiders from Canada, by J. Blackwall, (to be continued.)—Continuation of a Memoir on New Holland Cryptocephalides, by W. W. Saunders.—Continuation of a Memoir on new exotic Lucanidæ, by J. O. Westwood.—Descriptions of new Buprestidæ, from New Holland, by the Rev. J. W. Hope.—J. Doubleday on some new Diurnal Lepidoptera.—A description and plate of the Delphinus tursio, by T. Brightwell.

*Archiv für Naturgeschichte*, 1845, Part I.—Sars, on the development of an Acaleph, and the Annelida; with figures.—A. Philippi, new shells, from a voyage around the world, by his brother E. B. Philippi.—S. Müller, on the Quadrumana of Sunda.—J. Müller, on the structure and classification of the Ganoid fishes. Part II.—A. Wagner, on new Rodentia from Brazil.—J. J. de Tschudi, Conspectus of the Reptiles of Peru.—M. Gurlt, Enumeration of the species of Entozoa, arranged according to the animals in which they are found.

*Memoires de L'Institut de France*, Tome xviii, 1843.—M. Milne Edwards, Observations on the Compound Ascidiæ of the north coast of France; an elaborate memoir illustrated by several plates of great beauty and perfection. Tome xix, 1845.—G. Breschet, Anatomical and Physiological researches on the gestation of the Quadrumana.

## IV. Astronomy.

1. *Note on the Eclipse of the Sun of April next.*—On Saturday the 25th of April, there will be an eclipse of the sun, which although but partial, even where largest, in the United States, will without doubt be carefully observed by every astronomer, as it will also be visible in Great Britain, and therefore of great value for the determination of his longitude from Greenwich, and as it will be the last large eclipse that will be visible to us for upwards of eight years, and the last that will be total in our vicinity until Aug. 7th, 1869.

In the English Nautical Almanac and the French Connaissance des Tems, the approaching eclipse is called central and *annular*, it having escaped the notice of the computers of those works, that although the tabular diameter of the moon is less than that of the sun, it is so nearly equal thereto, that a few degrees of altitude will render it apparently the greater, and consequently, the eclipse where central, *total;* but even where longest (near the island of Eleuthera) the duration of total darkness will not exceed 51 seconds, or the diameter of the moon's shadow, 22 miles.

By the following table it appears, that the duration of the central eclipse on the earth will be $3^h\ 34\frac{1}{2}^m$, and the length of its path about 9000 miles. For thirteen minutes after the beginning, and about seventeen before the end, of the central eclipse, or for about half an hour only, it will be annular; during the remainder of the time, or for upwards of three hours, it will be total, but so small is the extent of *land* to which the eclipse will be central, and so narrow the shadow of the moon, that Sagua la Grande, a town on the north side of the island of Cuba, appears to be the only place of note or importance on the earth that will see a total eclipse.

During the remainder of the present century, there will be but five eclipses central in any part of the Atlantic States, viz. those of May 26, 1854, and Sept. 29, 1875, annular in Massachusetts, and that of Oct. 19, 1865, in the Carolinas; whilst those of Aug. 7, 1869, and May 28, 1900, will be total in North Carolina and Virginia.

The following elements of the sun and of the moon, according to Burckhardt, were taken from the Nautical Almanac, but those according to Damoiseau were very carefully computed for Paris for four intervals of two hours each, and thence reduced to the meridian of Greenwich. The difference between these lunar tables is sometimes very considerable, amounting to 15 seconds and upwards; but on this occasion this fortunately is not the case, as during the continuance of the whole eclipse, the greatest difference in longitude is $2\frac{1}{2}$ seconds, and in latitude and parallax $1\frac{1}{2}$ only.

Path of the central eclipse over the earth, April 25th, 1846. Mean time at Greenwich:

| Eclipse central at | In Latitude. | In Longitude. | Eclipse central at | In Lat. N. | In Lon. W. | Eclipse central at | In Lat. N. | In Lon. W. |
|---|---|---|---|---|---|---|---|---|
| *h. m. s.* | ° ′ | ° ′ | *h. m. s.* | ° ′ | ° ′ | *h. m. s.* | ° ′ | ° ′ |
| 3 3 11 | 2 13·9 s. | 135 47·5 w. | 4 28 00 | 21 19·2 | 82 55·2 | 5 17 30 | 27 51·7 | 67 25·5 |
| 3 3 18 | 1 27·8 | 132 39·7 | 4 29 00 | 21 28·7 | 82 37·3 | 5 20 00 | 28 7·1 | 66 32·6 |
| 3 5 00 | 0 24·1 n. | 126 3·8 | 4 30 00 | 21 38·1 | 82 19·5 | 5 22 30 | 28 21·9 | 65 38·7 |
| 3 7 30 | 1 57·2 | 121 20·6 | 4 31 00 | 21 47·4 | 82 1·7 | 5 25 00 | 28 36·1 | 64 43·8 |
| 3 10 00 | 3 9·5 | 118 1·6 | 4 32 00 | 21 56·7 | 81 43·8 | 5 27 30 | 28 49·8 | 63 47·8 |
| 3 12 30 | 4 11·9 | 115 22·3 | 4 33 00 | 22 6·0 | 81 26·0 | 5 30 00 | 29 3·0 | 62 50·5 |
| 3 15 00 | 5 8·1 | 113 7·1 | 4 34 00 | 22 15·2 | 81 8·1 | 5 32 30 | 29 15·6 | 61 52·0 |
| 3 17 30 | 5 59·8 | 111 8·6 | 4 35 00 | 22 24·4 | 80 50·3 | 5 35 00 | 29 27·5 | 60 52·1 |
| 3 20 00 | 6 48·3 | 109 21·9 | 4 36 00 | 22 33·5 | 80 32·4 | 5 37 30 | 29 38 9 | 59 50·8 |
| 3 22 30 | 7 34·1 | 107 44·7 | 4 37 00 | 22 42·5 | 80 14·6 | 5 40 00 | 29 49·6 | 58 47·9 |
| 3 25 00 | 8 17·7 | 106 15·2 | 4 38 00 | 22 51·5 | 79 56·7 | 5 42 30 | 29 59·6 | 57 43·4 |
| 3 27 30 | 8 59·5 | 104 51·9 | 4 39 00 | 23 0·4 | 79 38·8 | 5 45 00 | 30 9·0 | 56 37·1 |
| 3 30 00 | 9 39·7 | 103 33·8 | 4 40 00 | 23 9·2 | 79 20·9 | 5 47 30 | 30 17·6 | 55 28·8 |
| 3 32 30 | 10 18·5 | 102 20·0 | 4 41 00 | 23 17·9 | 79 3·0 | 5 50 00 | 30 25·3 | 54 18·5 |
| 3 35 00 | 10 56·0 | 101 10·0 | 4 42 00 | 23 26·6 | 78 45·0 | 5 52 30 | 30 32·2 | 53 5·9 |
| 3 37 30 | 11 32·4 | 100 3·2 | 4 43 00 | 23 35·3 | 78 27·0 | 5 55 00 | 30 38·3 | 51 50·8 |
| 3 40 00 | 12 7·8 | 98 59·2 | 4 44 00 | 23 43·9 | 78 9·1 | 5 57 30 | 30 43·4 | 50 33·0 |
| 3 42 30 | 12 42·3 | 97 57·6 | 4 45 00 | 23 52·4 | 77 51·0 | 6 00 00 | 30 47·5 | 49 12·3 |
| 3 45 00 | 13 15·9 | 96 58·4 | 4 46 00 | 24 0·8 | 77 32·9 | 6 2 30 | 30 50·4 | 47 48·4 |
| 3 47 30 | 13 48·8 | 96 1·0 | 4 47 00 | 24 9·2 | 77 14·7 | 6 5 00 | 30 52·1 | 46 20·8 |
| 3 50 00 | 14 20·9 | 95 5·3 | 4 48 00 | 24 17·5 | 76 56·5 | 6 7 30 | 30 52·5 | 44 49·2 |
| 3 52 30 | 14 52·3 | 94 11·2 | 4 49 00 | 24 25·7 | 76 38·3 | 6 10 00 | 30 51·5 | 43 13·1 |
| 3 55 00 | 15 23·1 | 93 18·5 | 4 50 00 | 24 33·9 | 76 20·0 | 6 12 30 | 30 48·8 | 41 31·9 |
| 3 57 30 | 15 53·2 | 92 27·0 | 4 51 00 | 24 42·0 | 76 1·7 | 6 15 00 | 30 44·3 | 39 44·7 |
| 4 00 00 | 16 22·7 | 91 36·5 | 4 52 00 | 24 50·0 | 75 43·3 | 6 17 30 | 30 37·7 | 37 50·5 |
| 4 2 30 | 16 51·7 | 90 47·0 | 4 53 00 | 24 58·0 | 75 24·8 | 6 20 00 | 30 28·7 | 35 48·1 |
| 4 5 00 | 17 20·1 | 89 58·3 | 4 54 00 | 25 5·9 | 75 6·3 | 6 22 30 | 30 16·8 | 33 35·5 |
| 4 7 30 | 17 48·0 | 89 10·4 | 4 55 00 | 25 13·7 | 74 47·7 | 6 25 00 | 30 1·2 | 31 9·9 |
| 4 10 00 | 18 15·4 | 88 23·1 | 4 57 30 | 25 33·0 | 74 1·0 | 6 27 30 | 29 41·0 | 28 27·9 |
| 4 12 30 | 18 42·3 | 87 36·4 | 5 00 00 | 25 51·9 | 73 13·8 | 6 30 00 | 29 14·6 | 25 22·2 |
| 4 15 00 | 19 8·8 | 86 50·2 | 5 2 30 | 26 10·4 | 72 26·1 | 6 32 30 | 28 38·7 | 21 40·2 |
| 4 17 30 | 19 34·9 | 86 4·4 | 5 5 00 | 26 28·4 | 71 37·7 | 6 35 00 | 27 45·5 | 16 49·4 |
| 4 20 00 | 20 0·5 | 85 19·0 | 5 7 30 | 26 46·0 | 70 48·7 | 6 36 00 | 27 14·4 | 14 12·9 |
| 4 22 30 | 20 25·6 | 84 33·9 | 5 10 00 | 27 3·1 | 69 59·0 | 6 37 00 | 26 28·6 | 10 35·7 |
| 4 25 00 | 20 50·3 | 83 48·9 | 5 12 30 | 27 19·7 | 69 8·6 | 6 37 36 | 25 36·3 | 6 43·4 |
| 4 26 00 | 21 0·0 | 83 31·0 | 5 15 00 | 27 35·9 | 68 17·5 | 6 37 44½ | 24 54·4 | 3 44·4 |
| 4 27 00 | 21 9·6 | 83 13·1 | | | | | | |

Duration of central eclipse, . . $3^h\ 34^m\ 33\frac{1}{3}^s$.

Total, from . . . . $3^h\ 16^m$ to $6^h\ 21^m$.

Sun centrally eclipsed on the meridian at $4^h\ 55^m\ 54{\cdot}5^s$ in latitude 25° 20′·8, longitude 74° 30′·8.

Do. do. by Damoiseau at $4^h\ 55^m\ 59{\cdot}9^s$ in latitude 25° 22′·5, longitude 74° 32′·2.

Phases of the eclipse at several places in the United States and in the island of Cuba, in *mean* solar, civil time.

*** The points on the right and left sides of the sun, first and last touched by the moon, or at which the eclipse will begin and end, are counted from the vertex, as seen through an *erect* telescope. For a telescope that inverts, add 180°.

| | Boston, State House. | Cambridge, Astronomical Observatory. | Charleston, St. Michael's Church. | Cincinnati, Astronomical Observatory. | Eastport, Campobello Observatory. |
|---|---|---|---|---|---|
| Latitude, | 42° 21′ 23″ | 42° 22′ 48″ | 32° 46′ 33″ | 39° 5′ 54″ | 44° 53′ 33″ |
| Longitude, | 71 4 9 | 71 8 2 | 79 57 27 | 84 34 0 | 66 57 14 |
| | h. m. s. | h. m. s. | h. m. s. | h. m. s. | h. m. s. |
| Eclipse begins, | 11 14 45·1 M. | 11 14 27·3 M. | 10 3 36·9 M. | 9 55 14·1 M. | 11 42 51·0 M. |
| Apparent ecliptic ☌ | 0 33 54·1 A. | 0 33 31·6 A. | 11 30 11·3 " | 11 9 1·5 " | 0 59 25·1 A. |
| Greatest obscur'n, | 0 34 18·3 " | 0 33 54·9 " | 11 32 7·4 " | 11 11 35·9 " | 0 58 55·5 " |
| Eclipse ends, | 1 52 43·0 " | 1 52 18·1 " | 1 4 20·0 A. | 0 31 31·7 A. | 2 12 50·8 " |
| Duration, | 2 37 57·9 | 2 37 50·8 | 3 0 43·1 | 2 36 17·6 | 2 29 59·8 |
| Digits eclipsed, | 6° 40′ | 6° 39′ | 8° 49′ | 6° 14′ | 6° 9′ |
| Point first touched | 121 55 | 121 54 | 81 28 | 101 17 | 134 17 |
| Point last touched | 62 41 | 62 51 | 48 8 | 82 5 | 66 6 |

| | Havanna, the Morro. | Matanzas. | New York, City Hall. | Philadelphia, High School Observatory. | Washington, New Observatory. |
|---|---|---|---|---|---|
| Latitude, | 23° 9′ 26″ | 23° 2′ 30″ | 40° 42′ 40″ | 39° 57′ 8″ | 38° 53′ 41″ |
| Longitude, | 82 22 21 | 81 33 50 | 74 1 8 | 75 10 37 | 77 3 54 |
| | h. m. s. | h. m. s. | h. m. s. | h. m. s. | h. m. s. |
| Eclipse begins, | 9 29 58·9 M. | 9 34 21·1 M. | 10 54 49·7 M. | 10 46 43·6 M. | 10 33 56·9 M. |
| Apparent ecliptic ☌ | 11 2 24·0 " | 11 7 37·1 " | 0 14 57·6 A. | 0 7 17·1 A. | 11 54 44·7 " |
| Greatest obscur'n, | 11 2 51·9 " | 11 7 54·9 " | 0 15 58·6 " | 0 8 34·2 " | 11 56 10·3 " |
| Eclipse ends, | 0 44 17·7 A. | 0 49 40·5 A. | 1 36 57·7 " | 1 30 38·5 " | 1 19 51·2 A. |
| Duration, | 3 14 18·8 | 3 15 19·4 | 2 42 8·0 | 2 43 54·9 | 2 45 54·3 |
| Digits eclipsed, | 11° 34′ | 11° 44′ | 6° 56′ | 7° 4′ | 7° 12′ |
| Point first touched | 47 15 | 48 54 | 113 18 | 109 35 | 104 20 |
| Point last touched | 21 15 | 17 3 | 61 47 | 61 16 | 61 33 |

At Eastport, (Campobello Observatory,) the greatest obscuration will take place *before* the apparent ecliptic conjunction; and at each of the above places, the southern side of the sun will be eclipsed. For several of these places, the eclipse was also computed by the tables of Damoiseau, with the following results:

| | Beginn. sec. | Ap. ☌. sec. | End. sec. | Duration. sec. |
|---|---|---|---|---|
| Boston and Camb. | *Add* 1·8 | 5·7 | 7·8 | 6·0 |
| Charleston, | " 3·2 | | 7·8 | 4·6 |
| Cincinnati, | " 1·4 | 6·6 | 10·0 | 8·6 |
| Eastport, | " 1·2 | 5·3 | 7·6 | 6·4 |
| Philadelphia, | " 2·0 | 6·2 | 8·1 | 6·1 |
| Washington, | " 2·1 | 6·3 | 8·1 | 6·0 |

At Belize, (Fort St. George,) Honduras, lat. 17° 29′ 20″, long. 88° 8′ 20″, the greatest obscuration will take place at 10h. 16m. 39s. M. Digits eclipsed 11° 46½′ on the *north* limb.

At Cardenas, Cuba, lat. 23° 2′ 30″, long. 81° 11′ 50″, greatest obscuration at 11h. 10m. 18s. M. Digits eclipsed 11° 47′ on the *south* limb.

At Cienfuegos, lat. 22° 7′ 30″, long. 80° 37′ 40″, greatest obscuration at 11h. 12m. 42s. M. Digits eclipsed 11° 54′ on the *north* limb.

At Santa Clara or Villa Clara, lat. 22° 22′ 30″, long. 80° 5′, greatest obscuration at 11h. 16m. 34s. M. Digits eclipsed 11° 55′ on the *north* limb.

At the following places, the eclipse will be total, and very nearly central.

| | *Sagua la Grande.* Lat. 22° 48′ 20″, Lon. 80° 4′ 35″. | | *Place near Sagua.* Lat. 22° 42′ 18″. Lon. 80° 14′ 30″. | |
|---|---|---|---|---|
| | Burckhardt. | Damoiseau. | Burckhardt. | Damoiseau. |
| | h. m. s. | h. m. s. | h. m. s. | h. m. s. |
| Beginning of the eclipse, . | 9 42 29·3 M. | 9 42 34·3 M. | 9 41 20·9 M. | 9 41 26.1 M. |
| " total darkness, | 11 16 51·5 | 11 16 58·6 | 11 15 36·8 | 11 15 44·7 |
| Nearest approach of centres, | 11 17 16·5 | 11 17 23·6 | 11 16 1·8 | 11 16 8·8 |
| End of total darkness, . . | 11 17 41·5 | 11 17 48·5 | 11 16 26 8 | 11 16 32·9 |
| " the eclipse, . . . | 0 59 30·0 A. | 0 59 36·8 A. | 0 58 17·1 A. | 0 58 23·9 A. |
| Duration of total darkness, | 50.0 | 49·9 | 50·0 | 48·2 |
| " the eclipse, . | 3 17 0.7 | 3 17 2·5 | 3 16 56·2 | 3 16 57·8 |
| Point first touched, . . . | 47° 31′ | 47° 27′ | 47° 15′ | 47° 11′ |
| " last touched, . . . | 11° 11′ | 11° 4′ | 11° 16′ | 11° 10′ |
| At the nearest approach { Dist. north limbs, | 8″·55 | 6″·56 | 7″·63 | 5″ 63 |
| " of centres, | 0″·57 | 1″·51 | 0″·35 | 2″·44 |
| " south limbs, | 7″·41 | 9″·58 | 8″·33 | 10″·51 |

Elements of the Eclipse, mean time at Greenwich:

| Hour. | ☉'s Long. | Lat. | Rt. Ascen. | Declinat. | Semidi. | Sid. time. | |
|---|---|---|---|---|---|---|---|
| | ° ′ ″ | ″ | ° ′ ″ | ° ′ ″ | ′ ″ | h. m. s. | |
| 2 | 34 57 13·83 | —0·19 | 32 40 10·58 | 13 10 57·92 | 15 54·48 | 2 12 48·20 | |
| 3 | 34 59 39·75 | —0.20 | 32 42 31.79 | 13 11 46·80 | 15 54·47 | 2 12 58·05 | Obliquity 23 27 26·46 |
| 4 | 35 2 5·66 | —0·20 | 32 44 53·01 | 13 12 35·66 | 15 54·46 | 2 13 7.91 | ☉'s Hor. Par. 8·52 |
| 5 | 35 4 31·56 | —0·21 | 32 47 14·24 | 13 13 24·49 | 15 54·45 | 2 12 17·77 | Ellipticity $\frac{1}{300}$ |
| 6 | 35 6 57·46 | —0·22 | 32 49 35·49 | 13 14 13·30 | 15 54·44 | 2 12 27·62 | |
| 7 | 35 9 23·36 | —0·22 | 32 51 56·75 | 13 15 2·09 | 15 54·43 | 2 12 37·48 | |
| 8 | 35 11 49·26 | —0·23 | 32 54 18·03 | 13 15 50·86 | 15 54·42 | 2 12 47·34 | |

Lunar Elements according to Burckhardt:

| Hour. | Longitude. | Latitude. | Right Ascen. | Declination. | Hor. Par. | Hor. S. D. |
|---|---|---|---|---|---|---|
| | ° ′ ″ | ′ ″ | ° ′ ″ | ° ′ ″ | ′ ″ | ′ ″ |
| 2 | 33 28 51·91 | +20 28·25 | 31 7 41·18 | 13 0 22·3 | 57 58·23 | 15 47·78 |
| 3 | 34 2 49·96 | 17 20·16 | 31 41 34·64 | 13 8 57·8 | 57 56·73 | 15 47·37 |
| 4 | 34 36 46·25 | 14 12·16 | 32 15 28.71 | 13 17 28·4 | 57 55·23 | 15 46·96 |
| 5 | 35 10 40·77 | 11 4·25 | 32 49 23·39 | 13 25 54·1 | 57 53·72 | 15 46·54 |
| 6 | 35 44 33.52 | 7 56·43 | 33 23 18·69 | 13 34 14·9 | 57 52·20 | 15 46·13 |
| 7 | 36 18 24·48 | 4 48·72 | 33 57 14·60 | 13 42 30·6 | 57 50·67 | 15 45·71 |
| 8 | 36 52 13·65 | 1 41 15 | 34 31 11·13 | 13 50 41·2 | 57 49·13 | 15 45·30 |

Lunar Elements according to Damoiseau:

| Hour. | Longitude. | Latitude. | Hor. Par. | Hor. S. D. |
|---|---|---|---|---|
| | ° ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 2 | 33 28 51·23 | +20 29·69 | 57 56·73 | 15 47·87 |
| | ′ ″ 33 57·24 | ′ ″ 3 8·04 | | |
| 3 | 34 2 48·47 | 17 21·65 | 57 55·23 | 15 47·46 |
| | 33 55·75 | 3 7·98 | | |
| 4 | 34 36 44·22 | 14 13·67 | 57 53·73 | 15 47·05 |
| | 33 54·20 | 3 7·93 | | |
| 5 | 35 10 38·42 | 11 5·74 | 57 52·22 | 15 46 63 |
| | 33 52·58 | 3 7·88 | | |
| 6 | 35 44 31·00 | 7 57·86 | 57 50·70 | 15 46·22 |
| | 33 50·90 | 3 7·80 | | |
| 7 | 36 18 21·90 | 4 50.06 | 57 49·18 | 15 45·80 |
| | 33 49·17 | 3 7·70 | | |
| 8 | 36 52 11·07 | 1 42·36 | 57 47·64 | 15 45·39 |

Boston, February 9th, 1846. R. T. P.

2. *A new Planet.*—On the 8th of December, 1845, M. Hencke, of Driesen, found a star of the ninth magnitude in Taurus, where before there was none. At 8 o'clock, its place was A. R. 65° 25′, Dec. 12° 41′ N. On the 14th, it was observed by M. Encke, at Berlin, at 13h. 57m., m. t., A.R. 64° 0′ 23″·6, Dec. 12° 39′ 53″·1.

On the 24th, it was observed at London, by Mr. Hind, at 0h. 20m., sid. time, A.R. 4h. 8m. 17·56s., Dec. 12° 45′ 32″·6.

On the 30th of December, at 4h. 39m. Greenwich sid. time, it was found in A.R. 4h. 4m. 32s. Dec. 12° 55′ 26″.

This star is believed to be a new planet, near its opposition. Its motion was retrograde, and at the rate of about a quarter of a degree per day, through the month of December. It appears faint in a good 30 inch telescope. The discoverer left the determination of the name to M. Encke, who calls it *Astræa*.

The following approximate elements were furnished by Professor Schumacher.

| | |
|---|---|
| Mean longitude, 1840, Jan. 0, | 89° 32′ 12″·1 |
| Longitude of perihelion, | 214° 53′ 7″·0 |
| Longitude of ascending node, | 119° 44′ 37″·5 |
| Inclination of orbit, | 7° 42′ 8″·4 |
| Eccentricity, | 0·207993 |
| Semi-axis major, | 2·6390 |
| Mean daily motion in longitude, | 827″·65 |
| Periodic time, | 1565 days. |

According to these elements, the new planet approaches very near the orbit of Juno, and its eccentricity is nearly the same.

3. *Biela's Comet.*—This remarkable body has again made its appearance, and has been observed at various places in this country. It was seen at Cambridge, England, with the Northumberland Equatorial, December 1st, 1845. It passed its perihelion on the 11th of February, and will be nearest to the earth about the middle of March, when it may possibly be seen by the naked eye. This comet was observed in 1772, 1805, 1826, and 1832. During its present return, it has exhibited a very remarkable appearance. When first observed through the five inch refractor at Yale College, Dec. 29, 1845, the comet was seen attended by a faint nebulous spot preceding, estimated to be rather more than a minute of space distant from its brightest point. The few subsequent observations which the clouds and the moonlight permitted here before the middle of January, showed this secondary comet to be brightening faster than the principal, and slowly departing from it. This surprising phenomenon was first publicly announced in this country, by Lieut. Maury, of the Washington Observatory. On the 22d of January, according to Mr. S. C. Walker, the two portions were about

one and a half minutes of space apart. Each portion presented the usual characteristics of a telescopic comet, being gradually condensed towards the centre, without any well defined disc; each having a tail extending from the side opposite the sun.

The following are Santini's elements of this comet, as given in Schumacher's Ast. Nach., No. 491.

| | |
|---|---|
| Perihelion passage, | 1846, Feb. 11.40127 M. T. at Padua. |
| Longitude of perihelion, | 109° 4′ 29″·11 } Mean equinox |
| Longitude of node, | 245° 57′ 24″·46 } of Feb. 11, 1846. |
| Inclination, | 12° 35′ 25″·85 |
| Eccentricity, | 49° 10′ 39″·98 |
| Mean daily motion, | 537·653627 |
| Log. semi-axis major, | 0·5463360 |

The following ephemeris computed from these elements, is for 12h. mean time at Padua.

| | A. R. | Dec. | Log. dist. from sun. | Log. dist. from earth. |
|---|---|---|---|---|
| March 3 | 52° 7′ | 8° 44′ S. | 9·96124 | 9·6312 |
| 7 | 59 5 | 10 0 | 9·97253 | 9·6100 |
| 11 | 66 39 | 11 13 | 9·98500 | 9·5924 |
| 15 | 74 44 | 12 19 | 9·99834 | 9·5802 |
| 19 | 83 13 | 13 11 | 0·01228 | 9·5748 |
| 23 | 91 56 | 13 48 | 0·02668 | 9·5766 |
| 27 | 100 32 | 14 7 | 0·04128 | 9·5861 |
| 31 | 108 52 | 14 6 | 0·05596 | 9·6026 |
| April 4 | 116 38 | 13 52 | 0·07058 | 9·6252 |
| 8 | 123 47 | 13 27 | 0·08508 | 9·6527 |
| 12 | 130 16 | 12 55 | 0·09936 | 9·6831 |
| 16 | 136 4 | 12 21 | 0·11342 | 9·7162 |
| 20 | 141 28 | 11 49 | 0·12814 | 9·7520 |
| 24 | 145 54 | 11 15 | 0·14056 | 9·7846 |
| 28 | 150 8 | 10 47 | 0·15402 | 9·8196 |
| May 2 | 154 18 | 10 24 | 0·16638 | 9·8513 |
| 6 | 157 14 | 10 1 S. | 0·17878 | 9·8861 |

4. *Report on the erection of a Depot of Charts and Instruments at Washington city;* by Lieut. J. M. Gilliss, 1845.—A law authorizing the erection of a depot of charts and instruments for the navy, was passed by Congress during the session of 1841–'42. The site selected is in the southwestern part of the city of Washington, on the north bank of the Potomac. The ground was excavated to a depth of 8 feet, for the foundations of the walls and bases of all the piers, except that for the great telescope, which is 9 feet below the surface of the ground.

The central building is 50 feet square on the outside. It is two stories and a basement high, and is surmounted by a revolving dome 23 feet in diameter. There are four rooms on each floor, separated by

passages 10 feet wide, crossing each other at right angles. The diameter of the great pier at the base is 15 feet, and it is solid to a height of $10\frac{1}{2}$ feet, where the diameter is 12 feet. Upon this is erected a conical pier of hard burned brick, the diameter at the base being 12 feet, the height 28 feet; diameter at top 7 feet, and walls 3 feet thick. The pier is capped by New York flagging stone, on which rests the pedestal of the equatorial.

On the east and west sides of this edifice are wings, each 26 feet long, 21 feet wide and 18 feet high. There is also a wing to the south, 21 feet long, with the same breadth and height as the others. In the west wing is the meridian transit instrument, and the mural circle; in the east wing it is intended to place a meridian circle and a portable transit instrument, and in the south wing is the transit instrument in the prime vertical. There will also be a clock to each wing. The piers are of granite from Maryland. The pedestal for the great telescope is one block weighing about $7\frac{1}{2}$ tons; that for the prime vertical transit weighs $11\frac{1}{2}$ tons; and the axis of the mural circle rests upon a block whose weight is $3\frac{1}{2}$ tons. The dome weighs about 4 tons; rests on six 32 pound balls, and may be revolved by a power of ten pounds.

The magnetical observatory is in the form of a cross, the arms being 70 feet long, 10 feet wide, and 10 feet high, and is entirely under ground, the roof being 5 feet beneath the soil. Four marble pillars are placed at the extremities of the cross, for the support of the instruments, and three others near the center for the reading telescopes and scale—the observer occupying a seat in their midst. No iron or steel was used in the construction of any part of this building.

The great refractor was made by Merz and Mahler, of Munich, and reached Washington in May, 1844. The object glass is $9\frac{6}{10}$ inches in diameter, with a focal length $15\frac{1}{4}$ feet, and the time occupied in perfecting it was nearly two years. The finder has an object glass $2\frac{6}{10}$ inches aperture, with a focal length of 32 inches. The hour circle is 15 inches in diameter, and reads by two verniers to $2^s$; the declination circle is 21 inches in diameter and reads by four verniers to $4''$. The telescope is moved by a clock which may be detached at pleasure. The instrument is furnished with a filar-micrometer, having eight eye-pieces with magnifying powers from 100 to 1000. It is so arranged that the observer may have bright lines and a dark field, or bright field and dark lines; and the quantity of light is controlled at pleasure. There are two annular micrometers, and five ordinary eye-pieces, with powers from 150 to 750 times.

The cost of this telescope was $6000; its object glass alone being valued at $3,600.

The transit instrument was made by Ertel and Son, at Munich. Its object glass has an aperture of $5\frac{1}{2}$ inches, and a focal length of 88 inches, and was obtained from Merz and Mahler. The axis of the transit is 42 inches long. The telescope is formed of two conic frustrums of brass, so that the object and eye ends may be readily transposed. There are two circles eight inches in diameter for finders, reading by two verniers to 10″. The diaphragm contains seven vertical and two horizontal permanent wires, and a movable vertical wire. The cost of the instrument was $1480; the object glass alone $320.

The mural circle was made by Simms, of London, and was received in June, 1844. The circle is of brass, and is connected with the central portion by twelve spokes or radii. The whole is one cast. It is divided into spaces of five minutes each, upon a band of gold inlaid on the rim, or perpendicular to the plane of the circle. The telescope has an aperture of four inches, and a focal length of five feet. In its focus are seven vertical and one horizontal stationary wires, and a micrometer wire. Placed at equal distances round the circle are six reading microscopes. Five revolutions of the micrometer measure five minutes on the scale, and the heads are divided into sixty equal parts for seconds. Cost of the circle, $3550.

The transit in the prime vertical, was made by Pistor and Martius, of Berlin, and reached Washington in February, 1844. The axis is 42 inches long. The object glass of the telescope has an aperture of five inches, with a focal length of 78 inches. In the focus are placed two horizontal and fifteen vertical stationary wires, and one movable vertical wire. Cost of the instrument, $1750.

The comet seeker was made by Merz and Mahler. It has an object glass $3\frac{9}{10}$ inches in diameter, and focal length of 32 inches. It is mounted equatorially, has eye-pieces which magnify from 12 to 50 times, and cost $280.

Two astronomical clocks have been ordered, one of Mr. Charles Frodsham, London; the other of Mr. William C. Bond, of Boston. They cost $300 each.

*The magnetical instruments.*—The declinometer was made by Mr. Barrow, of London. The magnet bar is a rectangular parallelopiped, 12 inches in length, 0.85 inches in breadth, and 0.27 inches thick. It is suspended in a brass stirrup furnished with a mirror after the manner of Gauss. The suspension thread is composed of eight fibres of silk. The reading telescope has an aperture of 1·7 inches, and a focal length of 21 inches.

The bifilar magnetometer was also made by Mr. Barrow. It is constructed in the same general manner and of the same dimensions as the declinometer.

The balance magnetometer has also a needle 12 inches in length. It has a cross of wires at each end, attached by means of a small ring of copper. The axis of the needle is formed into a knife edge, the edge of which passes as nearly as possible through the center of gravity of the unloaded instrument. There is also a mirror above the knife edges of the needle, whose plane is perpendicular to the magnetic axis. The needle rests by its knife edges upon agate planes resting upon a marble base.

Fox's deflector, for the purpose of measuring the inclination and intensity, was made by Mr. George, of Falmouth.

The observatory is also furnished with a standard barometer by Newman; a dry and wet bulb thermometer; Daniell's hygrometer; self-registering thermometer; Osler's anemometer and rain gauge.

About 200 volumes, mostly of astronomical observations, were presented by different societies and astronomers of Europe, and 650 volumes were obtained by purchase, forming thus the nucleus of an astronomical library.

Thus, then, we have at last a naval, if not a national, observatory. As respects the number, dimensions, and probably also the quality of its instruments, it has few equals in Europe. The public are anxiously looking for the fruits of this noble establishment. May their reasonable expectations not be followed by disappointment.

5. *First Report of the Director of the Cincinnati Observatory*, Prof. O. M. Mitchell, 1845.—In May, 1842, the Cincinnati Astronomical Society was fully organized, and in June following, Professor Mitchell started for Europe to purchase a telescope. At Munich, he found an object glass of 12 inches aperture, which had been tested by Dr. Lamont, and pronounced one of the best ever manufactured. This was subsequently ordered to be mounted, and was purchased for $9437. The instrument arrived in Cincinnati in February, 1845. The corner stone of the observatory was laid by the venerable John Quincy Adams, in November, 1843. The observatory is 80 feet long and 30 feet broad, and is situated upon a lofty eminence to the east of the city proper. The front of the building presents a basement and two stories, while in the center, the building rises three stories in height. The pier is built of stone, and is grouted from its foundation on the rock to the top. The equatorial room is 25 feet square, and is surmounted by a roof so arranged as to be removed entirely during the time of observations.

The hour circle is 16 inches in diameter, and reads by two verniers to $2^s$. The declination circle is 26 inches in diameter and divided on silver to 5′, reading by verniers to 4″. The instrument has five common eye-pieces, and nine micrometrical, with powers varying from 100 to 1400.

This observatory is the result of the private munificence of 700 or 800 citizens of Cincinnati, each of whom has contributed in sums of $25 to the funds of the society.

It is said that this noble telescope has disclosed the 'beds of lakes and rivers' in the moon. We may safely infer however, that these are *dry* rivers. If there was any water on the moon's surface, a portion of it would be evaporated and form an atmosphere about the moon, which would reflect light, and affect the duration of occultations of the stars. A ray of light entering the earth's atmosphere obliquely, is refracted more than half a degree, and it experiences the same effect in emerging from our atmosphere, so that the total deviation of a ray of light just grazing the earth's surface is more than a degree. If the moon had an atmosphere of the same density as the earth, and its centre was interposed between us and a fixed star, the star would not be concealed, but would be seen with scarcely diminished brightness three quarters of a degree from the moon's disc. If the moon had an atmosphere capable of supporting a column of mercury only *one fiftieth of an inch* in height, it would produce an amount of refraction in the occultation of a star which would long since have been detected. But no indications of refraction, however minute, have ever been perceived; hence we may safely infer that there is no river either on the 'hither' or further side of the moon.

To complete the outfit of the Cincinnati observatory, there is wanted a clock and transit circle, without which the great refractor will be comparatively useless to science. The citizens of Cincinnati have excited the admiration of their own countrymen and of Europe, by their liberal patronage of the sublime science of astronomy; and we doubt not that the view of the heavens through their noble telescope will amply repay them for all the sacrifices they have made.

As the subject of astronomical observatories is attracting increased attention in this country, and we are almost daily hearing of the purchase of new instruments, it may be well to give an extract from the catalogue of Merz and Mahler's refractors.

No. 1. Refractor 21 feet focus, 14 (French) inches aperture; price 42,000 florins. [The florin is about 40 cents.] This is the instrument furnished for the Russian observatory at Pulkova, and a similar one has been ordered for Cambridge observatory, in this country.

No. 2. Refractor 17½ feet focus, 12 inches aperture; price 30,000 florins. This is the one purchased for the Cincinnati observatory.

No. 3. 15 feet focus, 10½ inches aperture, price 22,000 florins.

No. 4. 13½ feet focus, 9 inches aperture, price 15,000 florins. This is the one purchased for the Washington observatory.

No. 5. 9⅔ feet focus, 7 inches aperture, price 8000 florins.

No. 6. 8 feet focus, 6 inches aperture, price 4800 florins. This is the size which has been purchased for the Philadelphia and West Point observatories.

No. 7. 6 feet focus, 52 lines aperture, price 2200 florins.

No. 8. 5 feet focus, 48 lines aperture, price 2000 florins.

All the preceding dimensions are French, which are greater than English measure. 12 French inches are equal to 12·79 English inches.

## V. Arts and Manufactures.

1. *Effect of Heat on the Tenacity of Iron;* by Prof. W. R. Johnson, (from the Report on the strength of materials for steam-boilers, 1837.)—The following table exhibits the effect of heat on the tenacity of iron, both while actually hot and also subsequent to the application of a strain at high temperature. The comparisons are made on thirty two different specimens of iron, the origin of which is designated in the first column of the table. The page of the report of the sub-committee of the Franklin Institute, on the strength of materials for steam boilers, published in 1837, where the detail of the experiments is found, is given in the second column. The temperature at which either the "hot fracture" or the hot strain was made on each bar, and which produced the strengthening effect of "thermotension," is contained in the third column. The fourth contains the number of trials made on each specimen of iron to ascertain its strength in its ordinary state and temperature, as it came from the hammer or the rolls, and before being put under strain at a high temperature. Column fifth shows the number of times the specimen was broken or at least strained at the temperature marked in column third. Column sixth gives the number of fractures made on the specimen to obtain the average strength after being heated, strained and then cooled again to ordinary temperature. Columns seven, eight, and nine contain the absolute strength given in the three different states respectively. Column ten exhibits the per centage increase of strength by treatment with thermotension, and eleven the difference in strength between the iron at ordinary temperature in its original state, and that which it possessed while heated as in column third. In three cases only does it appear that the strength had been diminished by heating up to the point at which the trials were made. One of those trials was at 766°, one at 662°, and the third at 552°. The average temperature at which the effect was produced was 573·7°, at which point the eleventh column shows that the strength of thirty varieties of iron, was 5·9 per cent. greater than at ordinary temperatures, say at 60 or 80 degrees.

It also appears that the average gain of tenacity in thirty two samples of iron, by the process above mentioned, was 17·85 per cent., ranging from 8·2 to 28·2 per cent. It will be found on reference to

my report to the Bureau of construction, equipment and repairs of the Navy Department, that the average gain of length of bolts of iron treated at the Washington Navy yard, by this same process, was 5·75 per cent., and the gain of strength 16·64, making together the gain of value 22·4 per cent. The addition of 5·75 to 17·85, gives 23·6 per cent. for the total gain of value. In many instances the experiments made at the Franklin Institute proved the gain of length to exceed 7 per cent. The report to the Bureau also confirms what had previously been observed, viz. that the total elongation of a bar of iron, broken in its original cold state, is from two to three times as great as the *same force* would produce upon it if applied at a temperature of 573°, which force will moreover not break the bar at that temperature.

*Table exhibiting the effect of Heat on thirty-two varieties of Malleable Iron.*

| Name and origin of the specimen of iron tried. | Page of Franklin Institute Report, containing the trial. | Temperature of iron when proved hot. | No. trials for average ordinary strength. | No. of trials at high temperature. | No. of trials after heating & straining | Average strength in ordinary state and at ordinary temp'ture. | Strength exhibited while hot. | Average strength after applying thermo-tension. | Gain of tenacity per ct. by the treatment with thermotension | Diff. per ct. between original strength and that shown when the bar was hot. |
|---|---|---|---|---|---|---|---|---|---|---|
| Salisbury, (Conn.) gun bar, | 192 | 554 | 4 | 1 | 5 | 59,271 | 60,459 | 65,090 | 8·2 | + 2·0 |
| Maramee, (Mo.) bar iron, | 166 | 528 | 7 | 1 | 3 | 53,775 | 54,273 | 59,044 | 9·8 | + 0·9 |
| Phillipsburg, (Pa.) wire, | 158 | 500 | 4 | 2 | 4 | 79,720 | 80,488 | 84,187 | 10·4 | + 0·9 |
| Ellicott's Baltimore boiler plate, | 128 | 770 | 3 | 1 | 5 | 56,644 | 56,644 | 63,132 | 10·7 | ± 0·0 |
| " " " " | 130 | 662 | 4 | 1 | 7 | 58,899 | 58,181 | 64,820 | 10·9 | - 1·2 |
| Salisbury, (Conn.) gun bar, | 202 | 550 | 3 | 1 | 7 | 59,654 | 60,323 | 66,638 | 11·7 | + 1·1 |
| " " " | 200 | 590 | 4 | 1 | 9 | 59,032 | 62,952 | 67,384 | 13·5 | + 6·6 |
| Swedish bar iron, | 184 | 530 | 2 | 1 | 3 | 58,012 | 59,775 | 66,334 | 14·3 | + 3·0 |
| Nashville, (Tenn.) bar iron, | 172 | 520 | 7 | 1 | 5 | 54,934 | 58,451 | 62,600 | 14·5 | + 6·4 |
| Salisbury, (Conn.) gun bar, | 206 | 572 | 5 | 1 | 10 | 58,305 | 58,895 | 63,558 | 15·0 | + 1·0 |
| Ellicott's Baltimore forged bar, | 118 | 394 | 1 | 1 | 1 | 57,182 | 63,322 | 65,960 | 15·3 | +10·7 |
| Spang & Son,* ham'd plate, | 90 | 766 | 3 | 1 | 1 | 57,664 | 54,819 | 66,500 | 15·8 | - 4·9 |
| Blake & Co.* ham'd plate, | 104 | 572 | 6 | 1 | 4 | 60,532 | 62,278 | 66,941 | 16·3 | + 2·8 |
| Salisbury, (Conn.) gun bar, | 194 | 580 | 4 | 1 | 5 | 55,977 | | 65,883 | 17·0 | no hot frac. |
| " " " | 208 | 564 | 4 | 2 | 8 | 54,644 | 60,215 | 64,363 | 17·6 | +10·2 |
| " " " | 204 | 576 | 5 | 2 | 5 | 58,299 | 64,278 | 68,988 | 18·4 | +10·0 |
| " " " | 196 | 630 | 4 | 1 | 6 | 57,433 | 60,010 | 67,569 | 18·7 | + 4·5 |
| English "best-best" cable bolt, | 152 | 560 | 3 | 1 | 10 | 62,466 | | 71,000 | 19·3 | no hot frac. |
| Spang's Pittsburg ham'd plate, | 86 | 552 | 2 | 1 | 3 | 56,762 | 55,932 | 62,736 | 19·4 | - 1·4 |
| Nashville, (Tenn.) bar iron, | 178 | 560 | 7 | 1 | 6 | 52,729 | 58,534 | 62,127 | 19·5 | +11·0 |
| Mason & Miltenberger,* piled, | 82 | 574 | 4 | 1 | 2 | 55,426 | 60,083 | 68,339 | 19·5 | + 8·4 |
| Nashville, (Tenn.) bar iron, | 174 | 562 | 4 | 1 | 2 | 52,194 | 59,623 | 62,433 | 19·8 | +14·2 |
| Ellicott's Baltimore boiler iron, | 126 | 553 | 2 | 1 | 3 | 61,519 | 66,450 | 73,898 | 20·1 | + 8·0 |
| Schaenberger's Pittsburg boiler, | 114 | 630 | 1 | 1 | 3 | 53,803 | 56,159 | 64,926 | 20·6 | + 4·4 |
| Maramee, (Mo.) bar iron, | 164 | 564 | 5 | 1 | 9 | 49,974 | 52,158 | 58,126 | 20·6 | + 4·3 |
| Nashville, (Tenn.) bar, | 170 | 578 | 5 | 1 | 5 | 52,406 | 59,192 | 62,951 | 21·1 | +12·9 |
| Russia sable bar, | 180 | 584 | 5 | 1 | 3 | 76,071 | 77,161 | 92,470 | 21·5 | + 1·4 |
| Maramee, (Mo.) bar, | 162 | 576 | 6 | 1 | 4 | 43,386 | 50,067 | 53,368 | 23·0 | +15·4 |
| Ellicott's hammered bar, | 118 | 394 | 1 | 1 | 1 | 53,176 | 56,570 | 69,767 | 25·8 | + 6·4 |
| Salisbury, (Conn.) gun bar, | 198 | 575 | 3 | 1 | 6 | 52,873 | 60,988 | 66,685 | 26·6 | +15·3 |
| Maramee, (Mo.) bar, | 160 | 574 | 5 | 2 | 4 | 45,586 | 51,437 | 58,252 | 28·1 | +12·8 |
| Blake's Pittsburg ham'd plate, | 106 | 564 | 6 | 1 | 4 | 52,937 | 58,284 | 65,425 | 28·2 | +10·1 |
| Mean, | | 573.7 | 129 | 36 | 153 | | | Mean, | 17·85 | + 5·9 |

* Of Pittsburg.

2. *A new Photogenic Paper;* by M. GAUDIN, (Chemist, Aug. 1845, p. 363, from the Bull. de la Soc. d'Encouragement.)—A sheet of white paper is exposed for a minute to the vapor of hydrochloric acid; after which, a nearly saturated neutral solution of nitrate of silver is passed over its surface by means of a brush, (which must not be fastened by metal;) the paper is then allowed to dry, and the dry sheet is placed in the focus of the camera obscura; and on removing it, and wetting the paper with a nearly saturated solution of sulphate of iron, slightly acidulated with sulphuric acid, the image before invisible immediately appears. In order to fix the image, it must be well washed, first with pure water, and afterwards with water containing 10 per cent. of caustic ammonia. If the parts which ought to be white have a yellow tint, the paper, before being allowed to dry, must be washed in water acidulated with hydrochloric acid.

The image, of course, is reversed. In order to reproduce this image in its true position, it is placed upon a sheet of paper similarly prepared, and exposed to the action of light, until the edge of the paper (projecting beyond that upon which is the reversed image) becomes blackened; it is then washed in the solution of caustic ammonia, without treating it with sulphate of iron.

In order to reproduce the reversed images, they must be varnished, which removes the inequalities from the paper, and materially assists the operation. J. L. S.

3. *Improvement in Photography;* by W. H. HEWETT, (Phil. Mag., Nov. 1845, p. 405.)—This improvement consists in using the vapor of ammonia as an agent to accelerate the action of light upon the plate. The effect is produced upon a simple iodized plate, but still more upon a plate prepared in the ordinary way, with both iodine and bromine. By this means, the author obtained impressions instantaneously in the sunshine, and in five to ten seconds in a moderate light; and he hopes to be able to take moving objects. It can be applied by exposing the prepared plate over a surface of water, to which a few drops of ammonia have been added, (sufficient to make it smell of ammonia,) or the vapor can be introduced into the camera during the action. In fact, the presence of ammonia in the operating room appears to have a good effect, as it also neutralizes the vapors of iodine and bromine that may be floating about, and which are so detrimental to the influence of the light upon the plate. J. L. S.

4. *Wood for supporting Rails in Railways.*—M. BOUCHERIE renders wood for railways proof against decay, by saturating it, according to a method of his own, with either a sulphate of copper, or a double chloride of mercury and soda, or with chloride of calcium and pyroligneous

acid. He proposes to use other woods than oak, and states that his method increases the price of wood but four francs the stère.*

5. *Manufacture of Artificial Stone for Grinding, and other purposes;* by F. Ransem, (Chem. Gazette, Aug. 1845, p. 36.)—The method consists in cementing fragments of stone, by a soluble silicate of soda, and consolidating the mass by pressure. The cement is formed by dissolving 100 lbs. of crystallized carbonate of soda in 50 gallons of water, rendering the soda caustic by lime, and evaporating to 20 or 25 gallons: then place the solution in a boiler, with 100 lbs. of finely broken flints, or other siliceous material, and heat for 10 or 12 hours under a pressure of about 60 lbs. to the square inch, stirring it frequently. After this, the undissolved portion is filtered out, and the cement is ready for use; its degree of concentration may be varied by the addition of more of the siliceous material, or more water.

To make millstones, one part of powdered flint, or powdered pipe clay, and three or four of fragments of buhr-stone, or other suitable substance, are mixed with one part of the cement; the whole is subjected to heavy pressure in iron moulds, and afterwards is allowed to dry at the ordinary temperature for 24 hours; it is then put in a drying oven, and the temperature gradually raised to that of boiling water, and in this way completely dried. For stones of other kinds, granite, common sand, or any other similar material may be used, with one fourth to one sixth of the siliceous cement. By using very fine material, a coating for walls may be made. J. L. S.

6. *A new method of Blasting;* (Chemist, July, 1845, p. 310.)—M. Courbefaisse has found, that by enlarging the hole, for blasting, at bottom, either by chemical or mechanical means, much greater effect is produced by the powder, and the rock is lifted and rent, without being thrown to a distance. In a limestone rock, he uses hydrochloric acid for the enlargement of the hole required, applying it through a tunnel, in three or four successive doses. J. L. S.

## Miscellaneous Intelligence.

1. *Natives of Australia,* (Ethnography and Philology of the Exploring Expedition, by H. Hale.)—The natives of Australia are of the middle height, few of the men being above six or under five feet. They are slender in make, with long arms and legs, and when in good condition, their forms are pretty well proportioned. Usually however their wandering life, singular habits, and bad food, keep them extremely meagre; and as this thinness is accompanied by a protuberance of the abdomen, it gives to their figures a distorted and hardly human appearance.

* The stère is equivalent to 35·317 cubic English feet.

Their color is a dark chocolate or reddish black, like that of the Guinea negro, but varying in shade so much, that individuals of pure blood are sometimes as light-colored as mulattoes. That which distinguishes them most decidedly from other dark skinned races, is their hair, which is neither woolly, like that of the Africans and Melanesians, nor frizzled, like that of the Feejeeans, nor coarse, stiff and curling, as with the Malays. It is long, fine and wavy, like that of Europeans. When neglected, it is apt of course to become bushy and matted; but when proper care is taken of it, it appears as we have described. It is sometimes of a glossy black, but the most common hue is a deep brown. Most of the natives have thick beards, and their skins are more hairy than those of whites.

The impression produced on the mind of a stranger by an intercourse with the aborigines, in their natural state, is that of great mental obtuseness—or, in plain terms, an almost brutal stupidity. They never count beyond four, or, in some tribes, three; all above this number is expressed by a term equivalent to many. Their reasoning powers seem to be very imperfectly developed. The arguments which are addressed to them by the white settlers, for the purpose of convincing or persuading them, are often such as we should use towards a child, or a partial idiot. Their superstitions evince for the most part this same character of silliness. Some are so absurd as to excite at once laughter and amazement. The absurdity, it should be remarked, is not the result of an extravagant imagination, as with some portion of the Hindoo mythology, but downright childishness and imbecility. One instance, given on the authority of Mr. Threlkeld, missionary at Lake Macquarie, will probably be sufficient. In a bay, at the northwest extremity of that lake, are many petrifactions of wood, which the natives believe to be fragments of a large rock that formerly fell from heaven and destroyed a number of people. The author of this catastrophe was an enormous lizard of celestial origin, who collected the men together, and then caused the stone to fall. His anger had been excited against them by the impiety which they had evinced, in killing vermin (lice) by roasting them in the fire. Those who had killed them by cracking, were speared to death by him with a long reed which he had brought from the skies. When all the offenders were destroyed, the lizard reascended to heaven, where he still remains.

Although living constantly in what appears to us a most degraded state, and frequently suffering from actual want, they are nevertheless extravagantly proud. The complete personal independence to which they are accustomed, gives to their ordinary demeanor an air of haughtiness and even of insolence. They appear to have a sense, or it may almost be termed an instinct, of independence, which disposes them on

all occasions to assert their equality with the highest. They frequently observe on being asked to work, "White fellow works, not black fellow; black fellow gentleman."

It is not true, as has been frequently asserted, that the natives have no idea of a Supreme Being, although they do not allow this idea to influence their actions. The Wellington tribe, at least, believe in the existence of a deity called *Baiamai*, who lives on an island beyond the great sea to the east. His food is fish, which come up to him from the water when he calls to them. Some of the natives consider him the maker of all things, while others attribute the creation of the world to his son *Burambin*. They say of him, Baiamai spoke, and Burambin came into existence. A being, beyond question, of the creation of Australian imagination, is one who is called in the Wellington dialect *Wandong*, though the natives have learned from the whites to apply to him the name of devil. He is an object not of worship, but merely of superstitious dread. They attribute all their afflictions to his malevolence. If they are ill, they say Wandong has bitten them. No one can see this being but the *nuyargir* or conjurors, who assert that they can kill him, but that he always returns to life. He may however be frightened away by throwing fire at him, and no native will go out at night without a firebrand to protect him from the demon. At the Murruya river, the devil is called *Tulugal*. He was described to us by a native as a black man of great stature, grizzled with age, who has very long legs, so that he soon overtakes a man, but very short arms, which brings the contest nearer an equality. This goblin has a wife, who is much like himself, but still more feared, being of a cruel disposition, with a cannibal appetite, especially for young children. It would hardly be worth while to dwell upon these superstitions, but that they seem to characterize so distinctly the people, at once timid, ferocious and stupid, who have invented them.

2. *Origin of the Polynesians;* (ibid.)—The Polynesians extend over the Pacific Ocean, from the Sandwich Islands on the north to New Zealand on the south, an interval of 3700 miles, and occupy all the groups east of a line between these distant islands, excepting the Feejees. Mr. H. Hale in his account of the ethnography of those seas, shows satisfactorily that the original site or mother country from which migration took place, to the other parts of this extent of ocean, is the region of the Navigators (or Samoan) and Friendly Islands. The Society Islands and Rarotonga were settled direct from Samoa. The Gambier Islands from Samoa through Rarotonga. The Marquesas from the Friendly Islands and Samoa through Tahiti. The Sandwich Islands from Samoa through the Marquesas and Tahiti. New Zealand from Samoa. The Kingsmills from Samoa to the southeast, and from Ban-

abe, one of the Philippines, (called Ascension Island,) to the northwest. The island of *Savaii* is the largest in the Samoa group; and this name is retained in the traditions of all the groups, and is even given to some of the islands of these groups, as *Hawaii* at the Sandwich Islands. The course of argument on this subject will be presented in the next number of this Journal. The Friendly Islanders appear to have reached their islands through the Feejees; the natives of this last mentioned group are apparently a mixture of the Papuan with the Polynesian.

The Polynesians, as is well known, belong to the Malay race of the East Indies. Mr. Hale suggests some reason for inferring that they may be traced back to the island of Bouro, to the west of New Guinea.

3. *Cosmogony of the Polynesians;* (ibid. p. 24.)—Two stories are prevalent among the Samoans with regard to the creation of the world, or at least of their islands. Both attribute the work to their great god Tangaloa. According to one account, while the god was fishing, his hook caught in the rocks at the bottom of the sea, and in drawing it up he raised with it the whole group of Samoa. The other story represents him as forming the land by throwing down large stones from the skies, from which his daughter, Tuli, (snipe,) made the different islands. She afterward planted them with vegetables, one of which was a kind of vine, from whose stem a god named Ngai formed the first man, by marking out the body and members of a human being.

In Tonga the first of these stories is generally received. They add to the Samoan account, that when the god Tangaloa had raised the islands to their present altitude, his hook broke and left them in that situation; otherwise they would have continued to rise until they formed one great land. The New Zealanders and Tahitians have the same accounts of their islands having been drawn up by a god while fishing, and both give to this god the name of Maui, which, as we have before shown, is but another appellation for Tangaloa. The Tahitians have, besides, other stories, one of which,—to the effect, that the islands are fragments broken off from an immense rock,—has already been given. The word for rock is *papa*, which is also the name of the wife of Taaora, and from this source some confusion may have arisen, as some of the traditions relate that the islands were born of Taaora and Papa. The Hawaiians, according to Mo'o-olelo, before quoted, have the same story, that the islands were born of Papa, the wife of Atea, the progenitor of the human race.

The belief so generally prevalent, of the islands having been raised by a divinity, from the bottom of the sea, will appear natural enough if we consider the circumstances and character of the people. The situation of their islands, mere specks of land, surrounded by what must have appeared to the inhabitants an interminable ocean, and the fact

that the Polynesians are emphatically a nation of fishermen, would be sufficient to suggest the idea. When the priests, to whom the religion and mythology were especially committed, were called upon to account for the formation of the land which they inhabited, they would of course refer it to their great god Tangaloa or Maui, and no other mode would be so likely to occur to them as that by which they themselves had frequently drawn up fragments of coral rock from the bottom of the sea.

The fact that two or more stories are sometimes current on the same group, shows in what light they are regarded by the natives; not as articles of their religious creed, which they are bound to believe, but merely as traditions handed down from their fathers, which, though respectable for their antiquity, may, after all, not be true. Their opinions on this subject therefore differ widely from those which they hold with regard to the existence and power of their gods, of which none of them entertain a doubt.

4. *Cannibalism among the Polynesians*, (ibid., p. 37.)—The Polynesians may, without injustice, be called a race of cannibals. In New Zealand, the Hervey group, the Gambier Islands, the Paumotu Archipelago, and the Marquesas, the practice is, or was, universal, and is confessed by the natives with no apparent feeling of shame. In the Navigator, Friendly, Society, and Sandwich Islands, though not common, it was in former days occasionally practiced, and (which is the most important point) was not regarded with any great horror. By some it has been supposed that this custom originated in the fury of revengeful hostility; by others, in the cravings of hunger during seasons of famine. But the natives of New Holland, who are quite as ferocious as the Polynesians, and who frequently suffer severely from the want of food, are not cannibals.

There is in the minds of most men, savage as well as civilized, a certain notion of sanctity attached to the dead body of a human being,—a feeling of dread and repugnance at the idea of touching or disturbing a corpse,—which no effort can altogether vanquish. This feeling, however, appears hardly to exist among the people of these islands, as is apparent in several of their customs. It will be sufficient to mention two. The Polynesians do not, usually, like many savage tribes, torture their prisoners to death; nor are they wont, as a general thing, to preserve any part of the body of a slain enemy as a trophy,—though this is sometimes done. But it is their chief object, and especial delight, to secure the corpse, for the purpose of practicing upon it every horrible disfigurement which the imagination can devise. Mr. Ellis relates several of the modes in use among them, and remarks that some are too revolting to be described. No other race of savages has evinced this disposition to the same extent.

The other custom relates to the disposal of their dead. With most barbarous tribes, as well as civilized nations, the natural repugnance to the presence of a corpse is shown in the desire to put it away as soon as possible "out of their sight." The Polynesians have little or none of this feeling. In some islands, as in Tahiti and Nukuhiva, the bodies of the dead are (or were) exposed on stages near the dwellings of the living; in others, as at the Navigator and Sandwich Islands, they are buried either near or in the houses of their friends, and the skulls, and sometimes other bones, are afterward taken up and preserved as relics. At New Zealand, the body is placed on the ground in a sitting or crouching posture, and enclosed within the two halves of a canoe; this is set in the midst of their villages, which are often made unapproachable to a foreigner by the scent of putrefaction.

To a people like this, in whom the salutary awe of death is so completely extinct, who are naturally of a bloodthirsty disposition, and whose religious belief has nothing of a moral or elevating tendency, there is evidently no restraint but that of custom to deter them from cannibalism. The practice may have commenced in some excess of revenge, or in a season of famine; but it is now continued purely for the gratification of a depraved appetite. On this point the testimony of the natives themselves is distinct and positive; and as they are aware of the abhorrence with which the act is regarded by the whites, there can be no good reason for disbelieving them.

Of the four Oceanic races, the Polynesians and Melanesians are, generally speaking, addicted to cannibalism; while among the natives of Australia and Micronesia it is, so far as we are informed, unknown.

5. *Antarctic Continent.*—The *Pagoda*, despatched from England under the command of Lieut. Moore, to explore the Antarctic regions, between the meridian of Greenwich and 120° E., has found proof throughout of the existence of the Antarctic Continent, which they called *Victoria's* Land. The magnetic observations commenced by the *Erebus* and *Terror* have been completed, and the position of the magnetic pole exactly ascertained.

6. *Potato-disease.*—According to information received by Boussingault from M. Joachim Acosta, of Bogota, the potato-disease is well known on the plateau of Bogota, and prevails especially in rainy years, or in damp places. It is well known that the potato is indigenous to that region. The people use the tainted potatoes, after removing the diseased part.

7. *Expedition to Siberia*, (L'Institut, November, 1845, No. 619, page 397.)—The Siberian Commission have recommended a new expedition into Siberia and the Frozen Seas of the North, with special reference to the mean temperature of the regions, and

their animals and plants. Middendorf had ascertained that the temperature of the soil at Turuchansk (obtained by digging pits) was near zero, C., (32° F.,) whilst the isothermal line on Mahlman's chart of the temperature of the air at this place, is that of $-10°$ C. (14° F.) The great disparity renders this a point meriting particular attention; and observations in pits or wells are recommended, and series of such observations along meridians, to ascertain whether there is a decrease of temperature in the soil on going north.

8. *Ascension of the Snowy Peak, Kasbek, Persia*, in 1844; by Dr. Kolenati, (L'Institut, Nov. 1845, No. 619, p. 397.)—The peak of Kasbek is 2308 toises in elevation above the sea, or 2077 above the village of Tifflis. Dr. Kolenati succeeded in making the perilous ascent, and has published an account of it, describing the different glaciers of Kasbek, their courses, the cause of the descent of one from Desdaroki to Dhagaur, and the attendant circumstances; also the rocks and vegetation, including much that is interesting in geology and physics.

9. *Tycho-Brahe;* (L'Institut, Nov. 1845, No. 619, p. 400.)—Prof. Heiberg, who is engaged in a work on the life and works of Tycho-Brahe, which will be published in the course of the year coming, is reported to have discovered in the ruins of the castle and observatory of Tycho, on the Swedish island Hveen, many utensils and implements used by this astronomer, in constructing his astronomical instruments. Besides these relics, there were also found several manuscripts in Latin, with Tycho-Brahe's signature, some treating on different topics of astronomy, and others containing reflections upon the events of the time, and also a few poetical fragments.

10. *Geology of Brazil;* (L'Institut, 1845, No. 621, p. 412.)—Dr. Lund is continuing his geological researches in the province of Minas Geraes, in Brazil, and has found in the marly clays of the calcareous caverns, remains of several animals, among which are two species of horses, and a colossal panther.

11. *Vesuvian Meteorological Observatory;* (L'Institut, Nov. 26, 1845, No. 621, p. 416.)—A new meteorological observatory has just been established on the summit of Vesuvius. It was inaugurated at the time of the late convention of the Italian Scientific Association, at Naples, and is placed on the celebrated mountain called Santissimo Salvatore.

12. *The Congress of German Naturalists*, whose last session was held at Nuremberg, will take place next year at Kiel, in the duchy of Holstein. The general agent for that session is M. Michaels, professor of chemistry at the University of that village.

13. *Electrical Lady.*—The electrical lady, particulars of whose singular case are given in vol. xxxiii, p. 394, of this Journal, has lately died.

We ascertain from Mr. W. Hosford, the physician who attended her, that her disease terminated in tubercular phthisis. From the time of the previous communication respecting her, to her death, she had repeated evidence that the singular faculty of electric excitement remained with her, though much enfeebled. It was exhibited only during periods of ill health, and then but for a short time. This is the testimony of the lady during her last sickness.

14. *Nuttall's Cabinet of Minerals for sale.*—This cabinet contains about two thousand choice specimens, generally not less than three inches square, and usually well crystallized. It is quite extensive, and is the result of many years' collection, purchase and exchange. Application can be made to G. W. Carpenter, No. 301 Market street, Philadelphia, where terms and further particulars can be obtained.

15. *Cabinet of Minerals of the late Dr. J. P. Young, of Edenville, N. Y., for sale.*—This cabinet contains one to two thousand specimens of well selected minerals, both foreign and domestic, particularly those from the localities of Orange Co., N. Y., and Sussex Co., N. J. Any information desired regarding it, may be obtained of Samuel D. Holly, of Edenville, who is desirous of disposing of it as early as possible.

16. The Highland Agricultural Society (Scotland) have awarded their premium of £50 sterling, (proposals for which were issued two years ago,) for the best essay on the chemical constitution of *oats*, to our young countryman, JOHN P. NORTON, Esq., of Farmington, Ct., who has been for the past two years a pupil in the laboratory of Prof. James F. W. Johnston, at Edinburgh.

## BIBLIOGRAPHY.

1. *Paléontologie Universelle des Coquilles et des Mollusques*, with an Atlas, representing all known species of fossils. *Mollusques vivants et Fossiles, ou description de toutes les espèces de Coquilles et des Mollusques, classées suivant leur distribution geologique.*—The above are the titles of two works which M. Alcide D'Orbigny proposes to publish, the one, a general work on Palæontology, and the other, confined to Molluscs, both fossil and recent. The *former* will constitute eight volumes in 8vo, and be accompanied with 1500 octavo plates; price of each number, containing 20 plates and the corresponding text, 6 francs. The *latter* work will extend to 10 volumes in 8vo, with 300 engraved plates; each number containing 5 plates and 5 leaves of text, 3½ francs; or 5 francs, with the recent species colored. Subscription is desired at Gide et Cie., Libraires-editeurs, rue des Petits-Augustins, 5, Paris.

M. d'Orbigny is desirous of obtaining the various publications, by American authors, bearing upon the subjects of the above mentioned works, and offers in exchange his own publications, a catalogue of which

is given on our advertising sheet. The value and high character of these publications are too well known to require comment from us. His Paléontologie Française is one of the best and most elegant works on this branch of science hitherto published. From 1826 to 1834, d'Orbigny was engaged in his travels in South America, and in that period traversed the continent from Patagonia to the equator, over the prairies and the mountain ranges. He has since been president of the Geological Society of France.

2. *Essai d'une Carte Géologique du Globe terrestre;* by A. Boue.—This chart, by one of the first geologists of France, gives a general view of the geology of the globe: its dimensions are about 3 feet by 2½. It was presented to the German Association, or "Reunion" of Naturalists, which met at Gratz, in September, 1844. It is published by J. Andriveau-Goujon, rue du Bac, No. 17, under the auspices of the Geological Society of France.

3. *Annales des Sciences Naturelles.*—A new series of this valuable scientific journal was commenced in 1844, under the direction of M. Milne Edwards, for Zoology, and Ad. Brongniart and J. Decaisne, for Botany. The typography, engravings, and the character of its memoirs, are of the highest order. Four volumes are issued annually, two devoted to Zoology, and two to Botany.

4. *First Annual Report of the Geology of the State of Vermont*, 1845; by C. B. Adams, *State Geologist, Burlington.*—We are glad to find that the public authorities of this State have at last awakened to the importance of having a geological survey of their valuable territory. So many of these useful labors have already been performed, that the path of inquiry is now plain, and if followed with zeal and discrimination, will yield important results. The present report of Professor Adams, is designed mainly to inform the Governor of the State and the Legislature, of the object and scope of the undertaking. As the appointment of a State Geologist in Vermont, is only a recent event, but little labor can have been done in the field; but we trust ample means will be provided for the accomplishment of the undertaking.

5. *New York Scientific Reports.*—The scientific reports under the direction of the State of New York, which have thus far appeared, are as follows:—

Zoology, by James E. De Kay—

1 volume in quarto on Quadrupeds, with 33 plates.
1 " " on Birds, with 141 plates.
2 " " on Reptiles and Fishes, with 79 plates.
1 " " on Mollusca and Crustacea, with 53 plates.

Mineralogy, 1 volume, by L. C. Beck.

Geology, 4 quarto volumes, severally by W. W. Mather, E. Emmons, James Hall, and Lardner Vanuxem.

Two volumes are yet to appear on the Fossils of the various rocks, by James Hall. This subject is a vast one; and it is alike honorable to the state and of great importance to the science of geology, that it promises to be carried out with the same completeness which has thus far characterized the whole series of Reports.

Besides these, there are to be two volumes on the Botany of the State by Dr. J. Torrey, and one on Agriculture, Insects injurious to vegetation, &c. by E. Emmons.

6. *Essay on Guano*, by J. E. TESCHEMACHER, pp. 51, 8vo, Boston; describing its properties and the best method of its application in agriculture and horticulture, with the value of importations from different localities, founded on actual analyses and on personal experiments upon numerous kinds of trees, vegetables, flowers, and insects in this climate.

7. *Reports on the Bear Mountain Railroad;* by EDWIN F. JOHNSON and WILLIAM R. CASEY, Civil Engineers: and *on the Coal and Iron Ores of the Bear Valley Coal Basin;* by JAMES HALL, with maps, profile, and geological cross section. Also an appendix, containing the charter of the company and statistics of the coal trade of the United States and Great Britain. pp. 88, 8vo. New York, 1845.

8. *Boston Journal of Natural History*, vol. v, No. 2, 1845.—Dissection of a Sperm Whale, and other Cetaceans, by J. B. S. Jackson.—Musci of Eastern Massachusetts, by J. L. Russell.—Descriptions and figures of the Araneides of the United States, by N. M. Hentz.—Descriptions of some new Insects of the United States, by J. L. Le Conte.—Plants from Texas, with descriptions of some new species, by. G. Engelmann and A. Gray.—Descriptions of the Fishes of Lake Erie, the Ohio River, and their tributaries, by J. P. Kirtland.—New Fossil Footmarks, by J. Deane.—New species of Marine Shells of the United States, by H. C. Lea.—New Shells from the coast of Africa, by A. A. Gould.—Note on Melocactus viridescens, by J. E. Teschemacher.—Notice of two species of Linguatula, by J. Wyman. This number contains 14 plates beautifully executed.

9. *Proceedings of the Academy of Natural Sciences for November and December*, 1845, (vol. ii, No. 12.)—p. 299, New Fossil Footprints, by A. T. King, (see notice of the same, p. 268 of this volume.)—p. 300, A new species of Parus (P. septentrionalis) from the Upper Missouri, by E. Harris.—Description of new species of Coleoptera of the United States, by F. E. Melsheimer.—p. 318, Examination and analyses of the alluvial soil of the Nile, from Korosco in Nubia, by W. R. Johnson.

This number closes the second volume of the Proceedings of the Academy; the title-page and *Index* will be issued with the first number of the third volume. By a notice accompanying the number, the public are informed that complete copies of the Proceedings may be procured for $1 50 a volume. The Journal of the Society, which now

embraces *eight* octavo volumes, with numerous plates and illustrations, may be obtained at the reduced price of $2 per volume for the whole set, or $2 25 for a single volume, by addressing Mr. Wm. S. Vaux, chairman of the committee of publication, No. 145 Arch street, Philadelphia.

10. *The Southern Journal of Medicine and Pharmacy;* edited by J. Lawrence Smith, M. D., and S. D. Sinkler, M. D., Jan., 1846, No. 1, Vol. i, semi-monthly. Charleston: Burges & James, publishers.—This new medical journal is published in numbers of 120 pages each, neatly printed and very well edited. The bibliographical notices and reviews, abstracts from American and foreign journals, and new facts in pharmacy, are all uncommonly full and judiciously selected. The chemical part of the work could not be in better hands, and if continued as it is begun, its value to medical men will make it very generally read in all parts of the country.

11. *The Buffalo Medical Journal;* edited by Austin Flint, M. D.—Nine numbers of this monthly journal of medicine have appeared. Each number contains 24 pages, and includes much original matter, besides excerpts and bibliographical notices.

### CORRECTION.

In the notice of Sullivant's *Musci Alleghanienses*, on p. 71 of the last number of the Journal, an important mistake and omission occurs, which the editors are desired to correct in the ensuing number. The proper diagnosis and habitat of *Syrrhopodon? excelsus* has been left out altogether, and that of a very different moss, viz. *Leucophanes? Leanum* substituted for it. To make the proper correction, all that stands under No. 170, on pp. 71, 72, should be stricken out, and the following introduced in its place. A. Gr.

170. Syrrhopodon? excelsus (*n. sp.*).

Caule ascendente innovando-ramoso; foliis e basi subvaginante recurvis auguste lanceolatis costatis complicato-carinatis in medio margine reflexis apicem versus argute serratis punctulato-areolatis. . . . . .

Hab. summo in cacumine montis *Grandfather*, Carolinæ Septentrionalis, arboreus.

172. Leucophanes? Leanum (*n. sp.*).

Densissime cæspitosum, fastigiato-ramosum; ramis corpusculorum (fol. abortiv.) congestis acervulis terminatis; foliis lineari-subulatis convoluto-canaliculatis ecostatis subsecundis nitidis albido-viridibus, e compluribus stratis tubulosarum cellularum conformatis. . . . . .

Hab. in sylvaticis depressis inter montes *Alleghanienses*, ad arborum truncos putredine decompositos, necnon in Ohione, haud infrequens, at semper sterile: beat. *T. G. Lea*, scrutator muscorum in vicinia urbis *Cincinnati* indefensus, primum detexit.

## POSTSCRIPT.

1. Since the body of this number of the Journal was printed, we have received an interesting letter from CHARLES LYELL, Esq., dated Feb. 4th, at Claiborne, (Ala.) addressed to B. Silliman, Jr., from which we make the following extracts:

"As you expressed a wish to receive as early a notice as possible, of some of the results of my geological explorings in the South, I will send you a brief statement of several conclusions to which I have come since I entered Georgia and Alabama.

"1st. I have visited some of the principal localities where the bones of the gigantic Cetacean (the Zeuglodon) have been discovered in Clarke County, Ala., in the fork of the rivers Alabama and Tombeckbee, and find the geological position of the bones to be every where the same, namely, in the white tertiary limestone of the Eocene period, corresponding in age to that of the Santee River, in South Carolina, or of Burke County, in Georgia, or that of the upper part of the celebrated bluff of Claiborne, in Alabama.

"2d. The beds in which the remains of the Zeuglodon occur, are above the level of those Claiborne deposits, so well studied and described by Mr. Conrad in 1832–3, as containing several hundred perfectly preserved species of lower tertiary shells.

"3d. Part of the head of the Zeuglodon and vertebræ, extending to a length of 30 feet, were procured by Mr. Koch in 1845, at a place which I visited, 4½ miles southwest from Clarksville, Ala., in company with Mr. Pickett, who assisted in the exhumation made by Mr. Koch. But the main body of the vertebræ, (as I learn from the same gentleman, and other persons,) which entered into the skeleton exhibited in the United States in 1845, under the name of Hydrarchos, were procured in Washington County, Alabama, fifteen miles distant, in a direct line, from the place where the head was discovered.*

"4th. I have information of more than forty other localities, where separate bones of the same huge animal have been met with, in Clarke and Washington counties, all in such perfect condition, and each so bulky and so distant from the rest, that I can hardly doubt their having belonged to as many distinct individuals.

* Another correspondent (S. G. Houston, Esq.) gave us a confirmation of Mr. Lyell's statement, under date of Washington County, Ala., Nov. 1st, 1845. Mr. H. says that the fossils were found, a bone here and a bone there, scattered over a space of 25 miles by 10 or 12.—*Eds.*

"5th. The age of the nummulite limestone of Alabama, seems to have been involved in considerable obscurity, it having been commonly referred to the secondary period, or considered as an upper cretaceous formation, or as possibly intermediate in age between the tertiary and secondary strata. After visiting the neighborhood of Suggsville, Macon, and Clarksville, Ala., I am persuaded that it is a tertiary limestone newer than all the beds of the well known Claiborne bluff, and lying immediately above the calcareous rock in which the Zeuglodon occurs. It is therefore by no means in the lowest part of the Eocene system of the South. Hitherto I have always met with it in hills considerably higher above the sea, than the top of the bluff at Claiborne, a circumstance which, in a region where the stratification is horizontal, would imply a newer deposit, even if the sections near Suggsville and Clarksville, showing actual superposition, had been less satisfactory. I did not meet with the limestone in question in the bluff at Claiborne, which I have no doubt is owing to the fact that the calcareous strata are cut off at the top, before they extend upwards into the nummulitic beds.

"6th. The conclusion last stated, will make it necessary in future to omit from the list of cretaceous fossils, such species of shells as have been referred to the secondary formations, simply on the ground of their occurrence in the nummulitic limestone. The fossils which I met with most abundantly in the latter, were the Nummulites Mantelli, (Morton,) and Pecten Poulsoni. I also found in the lower part, Pecten perplanus, Ostræa panda, and Plagiostoma dumosum, a large species of Cypræa, a Lunulite, and other corals.

"7th. The shale of the tertiary white limestone country of Alabama, is covered, like that of the Savannah River in Georgia, with river deposits of red clay, with quartz gravel, fine yellow, white, and pink sands, white porcelain earth, and occasionally chert and clay with sand intermixed. In many places in Georgia, where the buhr-stone occurs in this series, I have found in it distinct casts of Eocene testacea and corals, and I have shown, in the Proceedings of the Geological Society of London, the manner of its superposition to the subjacent calcareous beds in Scriven County, Georgia, which is equally applicable at Claiborne and in Clarke County, Alabama. Whether this upper deposit in Alabama be Eocene, and identical in age with that of Georgia, as I suspect, I am unable as yet positively to prove by the evidence of organic remains, although I have met with some faint impressions of shells and silicified wood in Clarke County.

"8th. The underlying Eocene or white limestone series, has a very undulating surface, on which the newer beds, many hundred feet thick, were deposited. The inequalities having been thus removed, and the hollows filled up, the existing valleys were excavated in both de-

posits. From this disposition of the beds, it happens that a deep cut in one place may pass exclusively through the limestone, and then at another, in the immediate neighborhood, through the incumbent newer strata. At Claiborne itself the bluff at the new landing consists of the calcareous formation about 150 feet thick, with a capping of 20 feet of the newer deposit, while about a mile lower down in the same bluff the appearances are reversed, and the upper formation occupies more than 100 feet of the higher part of the bluff, the calcareous beds cropping out from beneath. The section given by me in the Quarterly Journal of the Goological Society, No. 4, p. 438, in reference to the Jacksonboro' beds in Georgia, will enable you to understand this arrangement."

2. *Discoveries with the Great Refractor at Cincinnati.*—In an interesting communication published in the Daily Atlas (Cincinnati) of Feb. 11th, 1846, Prof. Mitchell, the able director of the Cincinnati Observatory, announces that he has devoted all the time he could command, to an examination, with the noble instrument pertaining to that establishment, of a zone in the heavens, extending from 15° to 40° of Southern Declination. The number of new double and multiple stars already thus discovered amounts to one hundred and fifty five. Of those of the former class, the most interesting is *Antares*, a star of the first magnitude in *Scorpio*, which on the 13th June, 1845, Prof. M. detected to be accompanied by a minute stellar companion, distant only 1·7″, and this discovery he has confirmed by repeated observation. There is every reason to suppose that this splendid and often observed star, had never before been seen double. Of the latter class, is a triple star in the *Pleiades*. When first discovered, several months since, the three stars were precisely in the same straight line. By an observation of Feb. 9, 1846, it appeared that "the line drawn through the two minute stars, no longer passed through the centre of the larger star, and shows conclusively a rapid motion in the minute star next to the principal one." We shall wait with much interest for the many important discoveries yet to be revealed by the aid of this powerful instrument.

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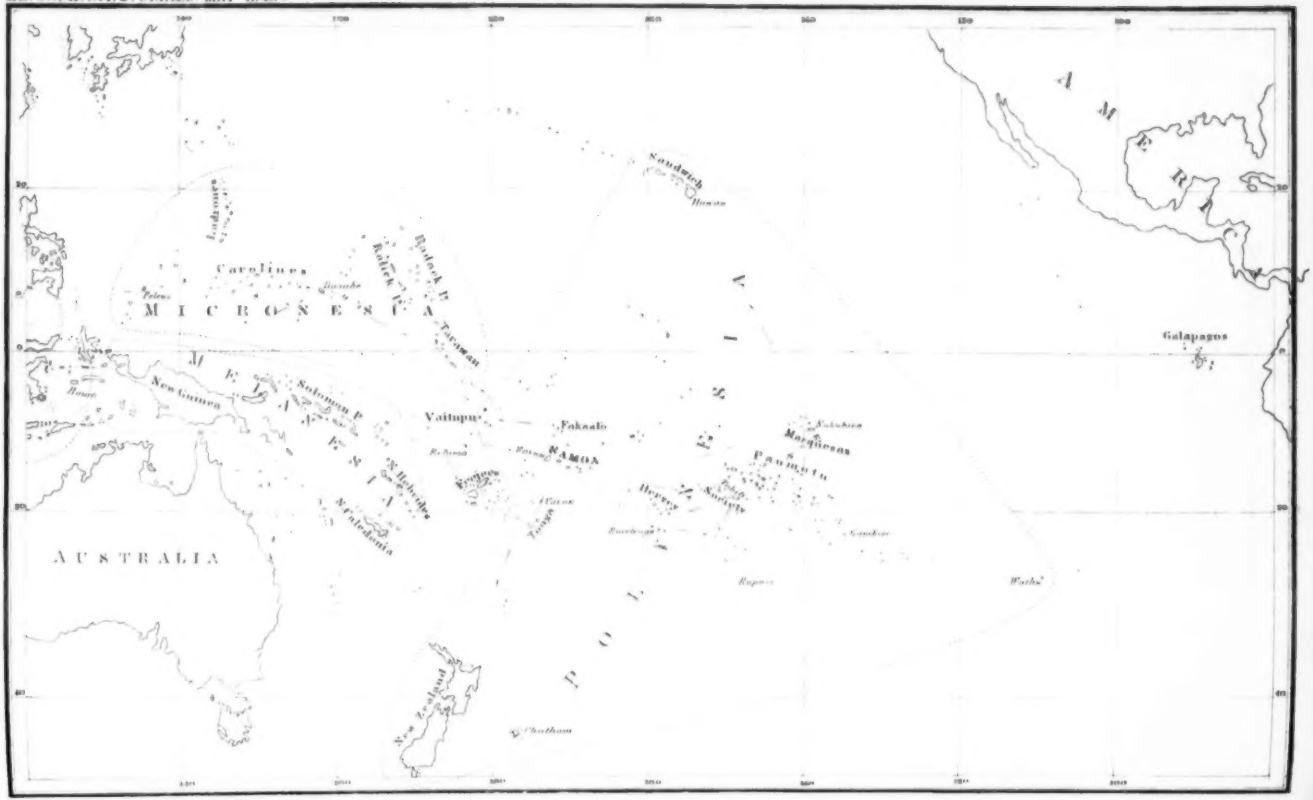
The plates designed to accompany Mr. Conrad's article on Eocene Fossils, at page 206 of this number, did not arrive from Philadelphia in season to be inserted in their proper place. They will be issued in our next.


Sandwich
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MICRONESIA
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New Guinea
Solomon I.
Vaitupu
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N. Caledonia
Tonga
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AUSTRALIA
New Zealand
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Rapa
Washington